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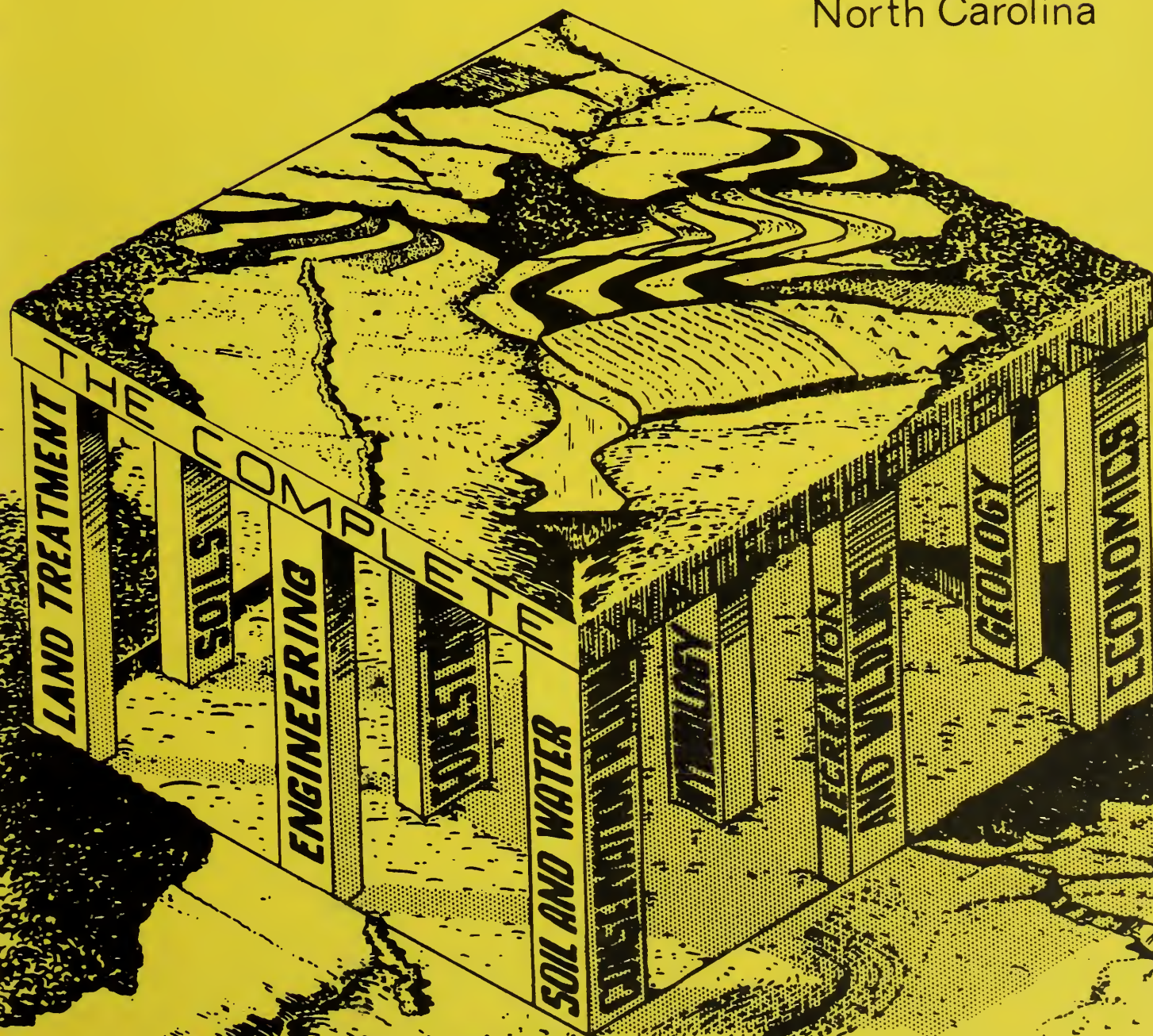
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BRYANT SWAMP WATERSHED

Work Plan

Bladen County
North Carolina



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ADDENDUM

BRYANT SWAMP WATERSHED

Bladen County, North Carolina

This addendum is prepared to present information consistent with the intent of the Principles and Standards for Planning Water and Related Land Resources which became effective October 30, 1973. The information presented is: Part I - Benefit to Cost Comparison; Part II - Abbreviated Four Account Displays; and Part III - Abbreviated Environmental Quality Plan.

PART I

The project costs, benefits, and benefit-cost ratio are based on a 5 7/8 percent interest rate, current normalized prices, and the 1974 price base. Annual project costs, annual benefits, and benefit-cost ratio are as follows:

1. Project costs \$41,350
2. Project benefits. \$70,995
3. Benefit-cost ratio. 1.7 to 1.0
4. Benefit-cost ratio without
secondary benefits. 1.5 to 1.0

PART II
SELECTED PLAN

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Bryant Swamp Watershed, North Carolina

<u>Components</u>		<u>Measures of Effects</u> ^{1/}		<u>Measures of Effects</u> ^{1/}
Income:		Income:		
Beneficial effects:		Adverse effects:		
A. The value of increased output of goods and services to users.		A. The value of resources required for a plan.		
1. Flood prevention	\$54,570	1. Approximately 22.9 miles of stream channel work with six grade-control structures		
2. Utilization of underemployed and unemployed resources	6,050			
Total Beneficial Effects	\$60,620	a. Project installation	\$26,650	
		b. Project administration	2,700	
		c. Operation and maintenance	12,000	
		Total Adverse Effects:	\$41,350	
		Net Beneficial Effects:	\$19,270	

^{1/} Average annual benefits and costs @ 5 7/8 percent interest.

August 1974

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

Bryant Swamp Watershed, North Carolina

<u>Components</u>		<u>Measures of Effects</u> ^{1/}		<u>Components</u>		<u>Measures of Effects</u> ^{1/}	
Income:		<u>Region</u> ^{2/}	<u>Rest of Nation</u>	Income:		<u>Region</u> ^{2/}	<u>Rest of Nation</u>
Beneficial effects:				Adverse effects:			
A. The value of increased output of goods and services to users residing in the region.				A. The value of resources contributed from within the region to achieve the outputs.			
1. Flood prevention		\$54,570	0 0	1. Project installation		\$10,405	\$16,245
2. Utilization of underemployed and unemployed resources.		6,050	0 0	2. Project administration		120	2,580
3. Secondary		11,700	0 0	3. Operation and Maintenance		12,000	0
Total Beneficial Effects:		\$72,320	0 0	Total Adverse Effects:		\$22,525	\$18,825
Employment:				Net Beneficial Effects:		\$49,795	-\$18,825
Beneficial effects:				Employment:			
A. Increase in the number and types of jobs.				Adverse effects:			
1. Employment from project construction		12 common labor jobs for 1 year	0	A. Decrease in number and types of jobs.		0	0
2. Employment from project O&M		2 permanent part-time semi-skilled jobs	0	Total Adverse Effects:		0	0
3. Indirect and induced employment from project installation and output of goods and services		8 permanent jobs in the trade and service sectors	0	Net Beneficial Effects:		8 permanent jobs	2 permanent part-time jobs
^{1/} Average annual.						12 man-years of common labor	
^{2/} The region consists of Bladen County, North Carolina							

Date: August 1974

REGIONAL DEVELOPMENT ACCOUNT (continued)

<u>Components</u>	<u>Measures of Effects</u>	
	<u>State of North Carolina</u>	<u>Rest of Nation</u>
Population Distribution		
Beneficial effects:	Create 8 permanent jobs in the trade and service sector; 2 permanent part-time semi-skilled jobs; and 12 common labor jobs for 1 year in an area where unemployment is high and population declined from 28,881 in 1960 to 26,477 in 1970.	0
Adverse effects:	None	None
Regional Economic Base and Stability		
Beneficial effects:	Provide drainage for 4,090 acres of crop and pasture land, and reduce erosion on 890 acres of land in a county where agricultural employment accounts for about 20 percent of all employment. Create employment in an area of low per capita income (\$2,196 in 1970) and high unemployment (6.5 percent in 1970); reduce floodwater damage to 22 business establishments in Bladenboro by 38 percent.	0
Adverse effects:	None	None

SOCIAL WELL-BEING ACCOUNT

Components

Measures of Effects

Beneficial and adverse effects:

A. Real income distribution.

1. Create 8 permanent medium income jobs; 2 permanent \$3,000/year part-time jobs; and 12 \$5,000/year jobs for 1 year.
2. Create regional income benefit distribution of \$97,505 by income class as follows:

Income Class - Disposable Income

Percent of Benefits in Class

Less than \$5,000
\$5,000 to \$10,000
\$10,000 plus

34
38
28

3. Local costs to be borne by region total \$66,285 with distribution by income class as follows:

Income Class - Disposable Income

Percent of Benefits in Class

Less than \$5,000
\$5,000 to \$10,000
\$10,000 plus

34
38
28

B. Life, health and safety.

1. Reduce risk of damaging floods in town of Bladenboro, thereby reducing the health and safety hazards of high water.
2. Provide for better mosquito control.
3. Improve septic system operation.

ENVIRONMENTAL QUALITY ACCOUNT

Components

Beneficial and adverse effects:

A. Areas of natural beauty

1. Project will protect, enhance and provide for management of 50 acres of wetlands near Bladenboro.

B. Quality considerations of water, land, and air resources.

1. Project will provide for accelerated land treatment of 890 acres of farm land subject to erosion, thereby reducing erosion, and improving the quality of land and water resources.
2. Project will provide protection of channels by enforcement of the statute prohibiting the disposal of tree laps and other refuse in channels.
3. Project will provide improved physical appearance of watershed area by providing for proper disposal of all kinds of refuse.

Measures of Effects

PART III
ABBREVIATED ENVIRONMENTAL QUALITY PLAN

Bryant Swamp Watershed, North Carolina

"The Principles and Standards specify that the overall purpose of water and land resource planning will be directed toward the improvement in the quality of life through contributions to the objectives of national economic development and environmental quality."^{1/} This plan is formulated according to the components of the environmental quality objective which are relevant to the planning setting. These components, and the measures proposed are:

- A. Management, protection, enhancement, or creation of areas of natural beauty and human enjoyment such as open and green space, streams and river systems, lakes and reservoirs, beaches, shores, wetlands, mountain and wilderness areas, and estuaries.
 - 1. It is proposed that the 50 acres of wetlands in Bryant Swamp located upstream from North Carolina Highway 410 can be protected from encroachment by zoning for non-development of the fringe areas, and be managed to create an improved wetland habitat. Management would include selective tree cutting and planting.
- B. Enhancement of quality aspects of water, land, and air by control of pollution or prevention of erosion and restoration of eroded areas embracing the need to harmonize land use objectives in terms of productivity for economic use and development with conservation of the resources.
 - 1. Land treatment measures proposed for 890 acres of land where sheet erosion is a problem include conservation cropping systems, crop residue use, cover crops, land smoothing, grassed waterways, and minimum tillage, which would reduce erosion by 35 percent. This sediment reduction, together with the end of sewage pollution when the sewage treatment facility now under construction at Bladenboro is completed, will allow the fishery resources in the lower two miles of Bryant Swamp to recover.
 - 2. It is proposed that a program for enforcement of the statute which prohibits the disposal of tree limbs and other refuse in channels and for proper disposal of all kinds of refuse be initiated.

^{1/} USDA Interim Procedures for Planning Water and Related Land Resources, p. II - 1, prepared by United States Department of Agriculture - Economic Research Service, Forest Service, Soil Conservation Service.

COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Bryant Swamp Watershed
Bladen County, North Carolina

(Dollars)

Evaluation Unit	AVERAGE		ANNUAL		BENEFITS		1/ 2/		Average		Benefit	
	: Reduction : Drainage :		: Secondary :		: Redevelopment :		: Total :		: Annual Cost ^{3/} :		: Cost Ratio :	
Stream Channel Work	33,890	20,680	11,700	6,050	72,320	38,650	1.9:1.0					
Project Administration	xxxxxx	xxxxxx	xxxxxxx	xxxxx	xxxxxx	2,700	xxxxxxx					
Total	33,890 ^{4/}	20,680	11,700	6,050	72,320	41,350	1.7:1.0					

- 1/ Price base: 1974 prices for all values except agricultural products which are adjusted normalized.
- 2/ Based on 5 7/8 percent interest rate.
- 3/ From Table 4
- 4/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$550 annually

Date: August 1974

WATERSHED WORK PLAN

BRYANT SWAMP WATERSHED

Bladen County, North Carolina

Prepared Under the Authority of the Watershed
Protection and Flood Prevention Act
(Public Law 566, 83d Congress, 68 Stat. 666),
as amended

Prepared by:

Bryant Swamp Flood Control Corporation

Town of Bladenboro

Bladen Soil and Water Conservation District

With Assistance by:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

January 1975

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CATALOGING - PREP

WATERSHED WORK PLAN AGREEMENT

between the

BRYANT SWAMP FLOOD CONTROL CORPORATION
Local OrganizationTOWN OF BLADENBORO
Local OrganizationBLADEN SOIL AND WATER CONSERVATION DISTRICT
Local Organization

(hereinafter referred to as the Sponsoring Local Organization)

State of North Carolina

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan of works of improvement for the Bryant Swamp Watershed, State of North Carolina, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan of works of improvement for the Bryant Swamp Watershed, State of North Carolina, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years,

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Bryant Swamp Flood Control Corporation will acquire with other than PL-566 Funds, such land rights as will be needed in connection with the works of improvement. (Estimated cost - \$101,000.)
2. The Sponsoring Local Organization assures that comparable replacement dwelling will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organization and the Service as follows:

	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Relocation Payment Costs</u> (dollars)
Relocation Payments	41.85	58.15	01/

3. The Bryant Swamp Flood Control Corporation will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.
4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
All Structural Measures	23.5	76.5	321,000

1/ Investigations have disclosed that the project measure will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost shared in accordance with the percentages shown above.

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Engineering Cost</u> (dollars)
All Structural Works	0	100	30,000

6. The Sponsoring Local Organization and the Service will each bear the costs of project administration which it incurs, estimated to be \$2,000 and \$44,000, respectively.
7. The Bladen Soil and Water Conservation District will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
8. The Bladen Soil and Water Conservation District will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
9. The Bryant Swamp Flood Control Corporation will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
11. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organization in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties.
13. At the request of Secretary James E. Harrington, North Carolina Department of Natural and Economic Resources, for James E. Holshouser, Jr., Governor, State of North Carolina, the following project requirements are included:
 1. The local sponsors will guarantee that 100 percent of the proposed land treatment measures will be installed prior to or in proper sequence with project construction.
 2. The local sponsors will take appropriate steps to have responsible local governments delineate floodways and establish floodway regulations on the main stem of Bryant Swamp from its confluence with Big Swamp, and also on those sections of laterals 6 and 7 located within the (Bladenboro) town limits, these actions to be taken before project construction is started.
 3. The local sponsors will take all reasonable measures to minimize adverse effects of the project on fish and wildlife and forest resources.
14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
15. The program conducted will be in compliance with all requirements respecting non-discrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States, shall on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving federal financial assistance.
16. This agreement will not become effective until the Service has issued a notification of approval and authorized assistance.

Bryant Swamp Flood Control Corporation
Local Organization

Box 215 Bladenboro, N.C. 28320
Address Zip Code

By Terry White

Title Chairman

Date 3/5/75

The signing of this agreement was authorized by a resolution of the governing body of the Bryant Swamp Flood Control Corporation adopted
Local Organization
at a meeting held on 2/13/75.

Eddie Roy Walters
Secretary, Local Organization

Date March 4, 1975

Box 177 Bladenboro, N.C. 28320
Address Zip Code

Town of Bladenboro
Local Organization

P.O. Box 455
Bladenboro, N.C. 28320
Address Zip Code

By Edgar L. Brown

Title Mayor

Date February 28, 1975

The signing of this agreement was authorized by a resolution of the governing body of the Town of Bladenboro adopted at a meeting held
Local Organization
on February 27, 1975.

Betty P. Bowen
Secretary, Local Organization

Date February 28, 1975

P.O. Box 455

Bladenboro, N.C. 28320
Address Zip Code

Bladen Soil and Water Conservation District
Local Organization

Soc 577, Elizabethtown, NC 28337
Address Zip Code

By E. Wade Byrd Jr.
Title Chairman
Date 3-6-75

The signing of this agreement was authorized by a resolution of the governing body of the Bladen Soil and Water Conservation District adopted
Local Organization
at a meeting held on 2-11-75.

Jack L. Lingg
Secretary, Local Organization
Date 3-6-75

Soc 577, Elizabethtown, NC 28337
Address Zip Code

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

Jane L. Nichols
State Conservationist
Date 3/12/75

TABLE OF CONTENTS

	<u>Page</u>
SUMMARY OF PLAN.....	1
WATERSHED RESOURCES - ENVIRONMENTAL SETTING.....	3
Physical Data.....	3
Economic Data.....	6
Fish and Wildlife Resources.....	7
Recreational Resources.....	8
Archaeological and Historical Values and Unique Scenic Areas.....	8
Soil, Water, and Plant Management Status.....	8
WATER AND RELATED LAND RESOURCE PROBLEMS.....	9
Land Treatment.....	9
Floodwater Damages.....	9
Erosion Damages.....	10
Sediment Damages.....	11
Problems Relating to Water Management.....	11
Irrigation.....	11
Municipal and Industrial Water.....	11
Recreation.....	12
Fish and Wildlife.....	12
Economic and Social.....	12
PROJECTS OF OTHER AGENCIES.....	13
PROJECT FORMULATION.....	13
Objectives.....	14
Environmental Considerations.....	14
Alternatives.....	15
WORKS OF IMPROVEMENT TO BE INSTALLED.....	18
EXPLANATION OF INSTALLATION COSTS.....	19
Land Treatment.....	19
Structural Measures.....	20
EFFECTS OF WORKS OF IMPROVEMENT.....	21
Flood Prevention, Erosion, and Sediment.....	21
Agricultural Water Management.....	23
Fish and Wildlife and Recreation.....	23
Archaeological, Historical, and Scientific.....	24

TABLE OF CONTENTS (Cont)

	<u>Page</u>
Economic and Social.....	24
Other.....	25
PROJECT BENEFITS.....	25
COMPARISON OF BENEFITS AND COSTS.....	26
PROJECT INSTALLATION.....	26
FINANCING PROJECT INSTALLATION.....	27
PROVISIONS FOR OPERATION AND MAINTENANCE.....	27
TABLE 1 -- ESTIMATED PROJECT INSTALLATION COST.....	30
TABLE 1A -- STATUS OF WATERSHED WORKS OF IMPROVEMENT.....	31
TABLE 2 -- ESTIMATED STRUCTURAL COST DISTRIBUTION.....	32
TABLE 2A -- COST ALLOCATION AND COST SHARING SUMMARY.....	33
TABLE 3 -- STRUCTURAL DATA - CHANNELS.....	34
TABLE 3A -- STRUCTURAL DATA - GRADE STABILIZATION STRUCTURES....	36
TABLE 4 -- ANNUAL COST.....	37
TABLE 5 -- ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS.....	38
TABLE 6 -- COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES.....	39
INVESTIGATIONS AND ANALYSES.....	40
Land Use and Treatment.....	40
Forestry.....	40
Engineering.....	40
Economics.....	41
Geology.....	43
Sediment.....	44
Biology.....	44
TYPICAL CROSS SECTION OF STREAM CHANNEL WITH SPOIL ON ONE SIDE	
PROBLEM LOCATION MAP	
URBAN FLOOD PLAIN MAP	
PROJECT MAP	

WATERSHED WORK PLAN
BRYANT SWAMP WATERSHED
Bladen County, North Carolina

May 1974

SUMMARY OF PLAN

Bryant Swamp Watershed, covering approximately 16,200 acres, is located entirely in Bladen County, North Carolina. It is in the middle coastal plain physiographic province. Bryant Swamp Canal originates in a flat densely forested pocosin northeast of Bladenboro and flows southwest into Big Swamp, a tributary of the Lumber River.

The watershed project is sponsored by the Bryant Swamp Flood Control Corporation, the Town of Bladenboro, and the Bladen Soil and Water Conservation District.

The purposes of the project are to provide flood prevention and drainage to the problem areas through land treatment and channel work.

Except for public roads, there is no State or Federal land in the watershed.

Accelerated sheet erosion occurs on 890 acres of cropland. The soils suffering erosion damages are the best suited for growing flue-cured tobacco and other high cash yielding crops. There are 4,090 acres of crop and pasture land subject to flooding from stream channel overflow along low-lying edges of fields adjoining forested flood plains and from pocosin overflow during extended periods of heavy rainfall. This same land has internal drainage problems because of inadequate outlets for on-farm drainage. Reduced quality crops, higher production costs, and reduced net returns are a result of the flooding and poor drainage. Essentially all of the main stream and alluvial flood plain is forested and subject to flooding.

A portion of the downtown business section of Bladenboro sustains flooding nearly every year. Twenty-two stores and other business establishments are subject to flooding from the 100-year frequency storm. There is minor flood damage to public roads, bridges, and streets.

The sponsoring local organizations have set the following objectives to be carried out over the life of the project: (1) develop 57 additional conservation plans during the project installation period; (2) reduce annual soil loss to sheet erosion on the gently sloping cropland; (3) provide adequate outlet channels for on-farm and small group drainage

Summary

projects; and (4) provide protection to the crop and pasture land from the 5-year, 24-hour frequency storm.

It was mutually agreed by the local sponsors and the Service that these latter two objectives would be accomplished by channels having capacity to remove the runoff from a 5-year frequency rainfall event in 24 hours.

Land treatment measures were considered as the basic element in project formulation. Vegetative measures to be installed consist of conservation cropping systems, cover crops, and crop residue use. Land treatment also includes structural measures, such as tile and open drainage laterals and mains.

Structural measures for flood prevention and drainage consist of approximately 121,000 linear feet (22.9 miles) of channel work and six grade-control structures. Channel work includes 7,950 feet of floodway.

Conservation land treatment will reduce erosion and sediment production by about 35 percent. Sheet erosion on 890 acres will be reduced to about 6.5 tons per acre. There will be benefits from less frequent flooding and improved drainage on 4,090 acres of crop and pasture land. Streets, public roads, and bridges will be protected from flooding from the approximate five year frequency storm. The major portion of the damage from flooding in Bladenboro will be eliminated. The floodway could damage approximately one mile of fishing stream. Approximately 50 acres of wetlands near Bladenboro will be lost or will have a reduced value as wildlife wetland habitat.

The project installation period is five years. Land treatment measures will be installed throughout the five years. Structural measures are scheduled for installation during the second year.

Land treatment measures to be installed are estimated to cost \$128,900, including technical assistance provided from Public Law 566 funds. The installation cost of structural measures is estimated to be \$498,000. Structural measures construction cost is estimated to be \$321,000. This cost will be shared at the rate of 76.5 percent by Public Law 566 and 23.5 percent of local funds. Public Law 566 funds will pay the engineering services and local funds will pay the land rights costs.

Operation and maintenance will be performed by Bryant Swamp Flood Control Corporation. The operation and maintenance cost is estimated to be \$12,000 annually.

Average annual benefits are estimated to be \$72,320. Benefits exclusive of secondary are estimated to be \$60,620. The overall benefit-cost ratio is 1.7 to 1.0.

The project will directly benefit approximately 2,000 people living in the watershed. The remaining 500 residents of the watershed will benefit from secondary effects stemming from and induced by the project.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Physical Data

Bryant Swamp Watershed, situated in Bladen County, in southeastern North Carolina, covers an area of 16,200 acres. The town of Bladenboro is located in the central part of the watershed. Elizabethtown (population 1,400), the county seat of Bladen County, is ten miles to the northeast and Lumberton (population 14,000) is ten miles to the northwest. Bryant Swamp Canal (a part of the Pee Dee River Basin) originates in a large densely forested pocosin (upland swamp) northeast of Bladenboro and flows southwestwardly to Big Swamp.

Population of the watershed is estimated to be 2,500. The make-up of the population is 1,100 farm, 800 urban, and 600 rural non-farm.

There are 4,090 acres of crop and pasture land with poor surface and internal drainage. Channels serving as outlets for this land are inadequate for the on-farm drainage systems. This same land is subject to overflow from both channels and forested pocosins during periods of excessive rainfall.

Portions of the downtown section of Bladenboro sustain flooding almost annually. Streets, public roads and bridges suffer minor flood damages.

Accelerated sheet erosion occurs on 890 acres of well-drained land in the lower portion of the watershed. Sediment from the gently sloping land near the drainageways is deposited in field ditches impairing drainage.

The watershed is in the middle coastal plain physiographic province. Average temperatures range from 46 degrees in January to 80 degrees Fahrenheit in July. The average frost-free season is 220 days. Annual rainfall averages 46 inches. The rainfall is fairly well distributed throughout the year. The highest average monthly rainfall occurs in July (slightly more than six inches) and the lowest average occurs in January, October, or November (slightly less than three inches).

The watershed includes three significant soil areas composed of:
(1) Coxville, Dunbar, Lynchburg, Goldsboro, Chipley, and Albany series;
(2) Lynn Haven and Leon soils; and (3) Hyde soils.

Most of the open agricultural soils are in the Coxville, Dunbar, Lynchburg, Goldsboro, Chipley, and Albany series. These soils are acid and range in natural drainage from poorly drained to moderately well drained.

In the edge of the large forested pocosins are flat areas of Lynn Haven and Leon soils. These soils are wet, sandy and very acid with a black to dark gray sand surface of 4 to 15 inches over white sand. Below 20 inches, the material is a firm brown sand. These soils are usually found with a cover of gullberry, buckleberry, and pine.

Resources

Within the forested pocosins are extensive areas of Hyde soils. The soil is acid throughout. The surface soil, 12 to 24 inches, is a black loam underlain by brownish gray clay loam or silty clay. The remaining forested soils are predominately sandy underlain with a fairly thick layer of organic material.

Elevations range from 130 feet mean sea level around the rim of the watershed down to 85 feet mean sea level at the outlet.

Geologically, the watershed is underlain by the Black Creek formation of late Cretaceous Age. The principal ground water aquifer is located in this 300 to 400 foot thick formation. In the Bryant Swamp Watershed, this formation receives water only as discharge occurs. Wells screened in 50 feet or more of sand, and properly developed, yield six to eight gallons per minute per foot of drawdown. The wells that tap the Black Creek formation are the only discharge points in the watershed for this aquifer.

Surficial deposits consisting of sand and sandy clay cover the Black Creek formation. These surficial deposits range in thickness from 10 to 30 feet and furnish water to many small domestic wells and ponds. The static water level in many of the wells is within five feet of the land surface. The surficial aquifer is fully charged at the present time.

Mineral resources consisting of sand and gravel deposits are located within the Bryant Swamp Watershed area. However, there is no known development of these minerals at the present time.

Land uses of the watershed are 4,180 acres of cropland (25.8 percent); 830 acres of pasture (5.1 percent); 1,050 acres of urban and built-up areas (6.5 percent); 470 acres of other (2.9 percent); and 9,670 acres of forestland (59.7 percent). The majority of the forested land is located around the perimeter and upper portion of the watershed. Consolidating small fields into larger ones and increasing livestock production will bring about land use change, principally in acres of pasture and forestland. By the time project installation is complete, land uses are estimated to be 4,120 acres of cropland (25.4 percent); 1,170 acres of pasture (7.2 percent); 1,050 acres of urban and built-up areas (6.5 percent); 685 acres of other (4.2 percent); and 9,175 acres of forestland (56.7 percent).

Higher value crops are grown on the better drained land. Most of the urban and built-up areas are located in and around Bladenboro, which is located in the center of the watershed.

The main stream from its origin to Bladenboro (approximately four miles) extends through a very gently sloping area of forested wetland with little or no defined flood plain. There is no evidence of channel work by excavation having been done along this portion of the main stream, except in

the vicinity of road crossings. The stream channel is poorly defined and in some areas there is no discernible run.

From Bladenboro downstream to the outlet into Big Swamp (approximately four miles), the main stream flows through a defined flood plain which becomes more pronounced as it progresses toward the outlet. The stream channel through this area is well defined, having been excavated about 35 years ago. The flood plain varies in width from about 500 feet to 1,500 feet. Essentially all of the alluvial flood plain is forested, with a few small areas fenced for native grass pasture and forestland grazing. Most of the merchantable timber in the flood plain has been harvested in recent years.

There are approximately 3.7 miles of laterals that have no defined channels. The remaining 13.2 miles of laterals are previously modified channels.

The main stem is a perennial stream (flows at all times except during extreme drought). The N. C. Department of Natural and Economic Resources has classified this stream as "C" swamp waters (suitable for fish) down to State Road 1133 and "D" swamp waters (suitable for agriculture) from State Road 1133 to the outlet. Lateral No. 11 (see project map) is an intermittent stream (continuous flow during some seasons but no flow during other seasons). The remaining laterals are classified as ephemeral streams (flows only during periods of surface runoff).

Limited data is available on the water quality of Bryant Swamp. Nine samples each were taken below the effluent discharge points of Bladenboro Cotton Mills and Bladenboro's waste treatment plant during the period June 1969 to August 1973. Dissolved oxygen had a range of 0 - 5.2 mg/l, giving a 0 - 54 percent saturation. The 5-day BOD is recorded for only one sample at each station. Adjusted to 20°C, these recordings were 7.0 and 4.5 mg/l respectively. The fecal coliform count ranged from 200 - 15,000/100 ml below the cotton mill and 100 - 2,000/100 ml below the waste treatment plant.

According to Wilder and Slack in Chemical Quality of Water in Streams in N. C., both Big Swamp and Lumber River have a hardness range of 0 - 10 mg/l of CaCO_3 . The range for nitrates NO_3 in mg/l are 1.0 - 1.9 for Big Swamp and 0.0 - 0.5 for Lumber River. Chloride ranges from 6.0 - 9.9 mg/l in Big Swamp to 3.0 - 5.9 mg/l for the Lumber River.

There are approximately 75 acres of Type 7 wetland habitat (U. S. Fish and Wildlife Service Circular 39) described as wooded swamps that are flooded with up to one foot of water at different times throughout the year. Approximately 50 acres of this type are located in and near the town limits of Bladenboro. The remaining 25 acres are located in the lower reaches of the project area above State Road 1128.

Resources

Economic Data

Except for public roads and streets, all the land in the watershed is in private ownership. The economy is largely dependent on agriculture and agriculturally oriented businesses. The major crops are tobacco, corn, small grain, and soybeans.

Peanuts and sweet potatoes are of lesser importance in terms of acreage. A few farmers engage in commercial livestock production. These enterprises are mainly for production of high quality beef cattle, a significant proportion of which is marketed as breeding stock. These operations require large capital investments. Livestock production accounts for about one-fourth of gross farm income.

There are 140 farms in the watershed. They vary in size from small units to a maximum of about 500 acres. The average size of farms is considered to be about 90 acres. According to the 1964 Census of Agriculture, the average value of farms in the area was approximately \$20,000. Based on recent selling prices of farm land in the area, the current value of a 90-acre farm would be in the range of \$35,000 to \$40,000.

Present yields per acre for the principal crops grown in the problem area include: tobacco - 2,000 pounds; corn - 80 bushels; peanuts - 1,500 pounds; oats - 46 bushels; and soybeans double-cropped - 26 bushels.

The value of crop and pasture land ranges up to \$500 per acre and the forestland is valued between \$100 to \$200 per acre. The urban and commercial land in and around Bladenboro ranges from \$1,000 to \$1,500 per acre.

The watershed is well served by transportation facilities. The Seaboard Coast Line Railroad passes through the watershed, connecting with the main north-south rail lines near Lumberton, and extends eastward to Wilmington, a major seaport terminal. There is also a good system of state highways providing easy access to markets, trade centers, and major U. S. and inter-state highways nearby.

Bladen County is designated under the Economic Development Act as an area of chronic unemployment and underemployment. Evidence of this condition is apparent in the watershed. The county's rate of unemployment (from 1964-1970) has ranged from a high of 9.6 percent (1964) to a low of 5.2 percent (1969). The 1970 unemployment rate was 6.5 percent. Labor force data shows that the civilian work force in 1970 was 8,710, while only 8,140 persons were gainfully employed. Manufacturing employed 2,390 (29 percent); non-manufacturing employed 2,860 persons (35 percent); agriculture employed, with some seasonal fluctuations, 1,950 (24 percent); and all other non-agriculture employed 940 (12 percent).

The county had a per capita income of \$2,196 in 1970. In the same year, North Carolina's per capita income was \$3,208, and the United States had a per capita income of \$3,910. Poverty is further indicated by the fact that in 1970 approximately 30.5 percent of the households in the county had incomes less than the poverty level as defined in the U. S. Commerce Department's 1970 population census. Based upon estimates of income sources for Bladen County, agricultural industries (SIC Codes 01, 07, 08, and 09) generated about 30 percent of the total personal income for the county in 1970. This amounted to \$57,692,000 according to the N. C. Department of Revenue, Tax Research Division. The remaining 70 percent of the county's total personal income was generated by manufacturing and other non-farm industries.

Fish and Wildlife Resources

Existing fish populations are influenced by movements of fish upstream from Big Swamp and are located primarily in the lower two miles (below State Road 1178) of the main channel. Game fish species present are: warmouth bass, redbfin pickerel, and bluegill. The fishery resource is affected by the presence of domestic pollution from Bladenboro. Periodic fish kills have been reported downstream from Bladenboro. Due to the lack of permanent water, the laterals are not considered capable of supporting a fishery resource. Because of the pollution, size of the stream, and limited access, the use of the fishery resource within the watershed is insignificant. The new sewage treatment plant presently under construction at Bladenboro will reduce the domestic and industrial pollution. With proper management, this should allow the section of Bryant Swamp below State Road 1178 to regain its status as a good fishery resource stream, as indicated by D. E. Louder's publication: Survey and Classification of the Lumber River and Shallotte River, North Carolina, dated 1962.

The fishery resource in Big Swamp is rated as one of the better fishing streams in the Lumber River Basin.

Game resources in the watershed consist primarily of upland species. Deer, quail, rabbit, and squirrel are abundant and hunting pressure on these species is heavy. The mourning dove, American woodcock, and various fur bearing animals are found in the watershed. Waterfowl habitat consists of approximately 50 acres located between North Carolina Highway 242 and State Road 1133, within or adjacent to the town limits of Bladenboro. Since this acreage is small and mostly located near a population center, it is generally of low value and receives only limited use by waterfowl populations. However, because of its location next to the population center of Bladenboro, it has value as a sanctuary for many forms of wildlife. An additional 25 acres of wetland habitat exists along the main channel between Bladenboro and State Road 1128. According to a report by the N. C. Wildlife Resources Commission, waterfowl hunting pressure is light with an estimated nine hunter-days annually. Deer,

Resources

bear, waterfowl, alligators, and various other wildlife are found in Big Swamp. There are few other areas of continuous forestland swamp in North Carolina as large or relatively unspoiled as Big Swamp.

Recreational Resources

Recreational resources within the watershed are limited primarily to areas set aside for team sports. Lake Waccamaw, located 30 miles to the southeast, outside the watershed, provides an opportunity for all types of water-based recreation. Bladen Lake State Forest, White Lake, and Singletary Lake, located 20 miles to the northeast, provide camping facilities as well as water-based recreation.

Archaeological and Historical Values and Unique Scenic Areas

According to the National Register of Historic Places, there are no known places of historic value located within the watershed. The N. C. Department of Art, Culture and History, Office of Archives and History, and the Research Laboratories of Anthropology at the University of North Carolina in Chapel Hill have no record of any places of historical or archaeological value or unique scenic areas being located in this area.

Soil, Water, and Plant Management Status

The cost-price squeeze caused by high mechanization expenses has forced the consolidation of small fields into larger ones and small farms into larger units. This trend is expected to continue. As this consolidation continues, it is expected that 495 acres of forestland will be converted to crop and pasture land. Most of this forestland is located around the perimeters of existing fields. There will be an estimated net decrease in cropland of 60 acres. Pastureland will undergo a net increase of about 340 acres. The remaining acres converted from forestland and cropland will be converted to other uses, such as wildlife, recreation, and home sites.

Open ditch drainage was installed when the land was cleared for cultivation. Most of these early ditches are now inadequate for both drainage and floodwater discharge. Low quality crops, higher production costs, and low net returns are all results of poor drainage within the root zones.

The soil and water conservation district has assisted 53 farm operators (38 percent of the total) in carrying out one or more conservation measures on their farms. Soil and water conservation plans have been prepared on 36 farms or 26 percent of the 140 farms in the watershed. These 36 farms represent 58 percent of the crop and pasture land. The above figures indicate the problems with getting land treatment measures installed in the watershed. Inadequate outlets exist for on-farm drainage. Wet field conditions force the operators to base their farming practices, such as cropping systems, crop residue management and land preparation, solely

on the moisture content of the fields most of the time. The problem is further aggravated by absentee landowners who lease their land on a yearly basis and farmers who work off the farm part-time.

It is estimated that 43 percent of needed land treatment practices are applied to date.

The N. C. Office of Forest Resources, in co-operation with the U. S. Forest Service, through the various Federal-State co-operative forestry programs, is providing forest management assistance, forest fire prevention and suppression, distribution of planting stock, and forest pest control assistance to private landowners in the watershed area.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land Treatment

According to soil surveys, 4,090 acres of crop and pasture land have problems caused by excess water which must be overcome before reasonable conservation and management practices can be utilized. A system of open drains was installed when the land was originally cleared for cultivation. Most of these early ditches are inadequate for both drainage and floodwater discharge required for modern, efficient agriculture. Modern equipment and consolidation of small fields are forcing the need for more efficient on-farm drainage systems, whereby tile drains are used in conjunction with relocated surface drains.

Even with on-farm drainage systems properly installed, efficient application of lime and fertilizer, conservation cropping systems, and crop residue management are needed to fully develop the productivity of the soils.

Sheet erosion is a problem on only a small part (890 acres) of the total watershed as most of the land is nearly flat. It is estimated that there are 8,775 tons of soil lost to erosion annually on this land. Some erosion occurs where surface water enters the channel and on gently sloping land.

Increasing use of larger equipment has required larger sized fields with fewer open drains. There is need for conversion to tile drains in lieu of field ditches.

Floodwater Damages

Flooding is a significant problem to both the agricultural and urbanized areas of the watershed. An estimated 4,090 acres of crop and pasture land (valued at about \$500 per acre) suffer flood damage. Damage stems from inability to remove surface runoff from abnormally heavy rainfall

Resource Problems

and from stream channel overflow along low-lying edges of fields. Direct flood damage to crops and pasture is estimated at \$26,500 annually.

A portion of the downtown business section of Bladenboro sustains flooding almost annually. Twenty-two stores and other business establishments are subject to flooding from the 100-year frequency storm. Three damaging floods have occurred within the last ten years. The largest one, in October 1964, resulted from a storm approximating the 100-year frequency and caused damage estimated at \$41,000 to businesses in Bladenboro. Lesser floods occurred in June of 1966 (estimated damages - \$5,500) and February 1971 (estimated damages - \$10,000). Records in the Bladenboro Town Office indicate that a flood comparable to the October 1964 flood occurred in 1924. Local businessmen reported that some flooding of streets and low places occurs once or twice each year on the average, but that damages from these small floods are minor and are limited mostly to inconvenience. Flood stages for the larger storms are low but cover a large area of the business section. Maximum flood depth over any store floor was found to be 1.7 feet with most stores having only a few inches of flooding. Flooding of residences is limited to shallow water over lawns and in a few small storage outbuildings. Average annual direct flood damage to urban property was estimated at \$8,100.

Minor flood damage to public roads, bridges, and streets is experienced. Minor repairs to paved surfaces and regrading of unpaved roads are required after floods. Damages were estimated to average \$1,990 annually.

According to the executive chairman of Industrial Development of Bladenboro, industrial prospects have turned down Bladenboro as a building site because of the lack of sites free of drainage and floodwater problems.

The Bladen County Health Director stated that improper drainage adds to problems caused by pollution by creating odor nuisances, fly and mosquito breeding areas, and spread of human diseases. Poor drainage of surface water allows stagnant water to accumulate, which compounds these pollution problems.

Erosion Damages

Accelerated sheet erosion on about 890 acres of gently sloping land is a problem in the Bryant Swamp Watershed. The soils suffering damages are best suited for the production of flue-cured tobacco and other high cash yielding crops. Severe damage has already occurred on some of these acres and further erosion will decrease their suitability for the production of tobacco and other row crops. Farm income in the watershed would decrease if erosion forces this land to be relegated to a lower order of use, such as pasture or forestland. The eroding land is adjacent to the canal, tributaries, and other drainageways. Floodwater flows slowly over the forested flood plain below Bladenboro and flood plain scour is not a problem.

A careful field study did not reveal any examples of instability in recently modified channels. There are no critical sediment source areas in this watershed.

Sediment Damages

The source of most sediment is the gently sloping cropland. This land is near the drainageways and delivery ratios are high. Sediment is deposited in field ditches causing impaired drainage. The damage is reflected in lower yields and increased difficulty in cultivating the land. Little or no land has been swamped to the extent that it has been put to a less intensive land use. Practically all of the open land is still used for crops and pasture.

Nearly all of the sediment delivered from the field ditches and roads is being deposited in the alluvial flood plain. The flood plain has always been wet and covered with bottom-land hardwood vegetation and infertile deposition has caused only minor damages in the past. The average annual turbidity of the water from Bryant Swamp entering Big Swamp is estimated to be about five milligrams per liter.

Problems Relating to Water Management

Poor drainage and flooding of the crop and pasture land is the basic water management problem in the watershed. It is caused by inadequate capacity and depth of channels that serve as outlets for on-farm ditches and drainage systems. These systems have been installed on most of the farms in the watershed. Floodwater and poor drainage combined cause high production costs and low quality crops, thereby providing low net returns for the farmers in the watershed.

Poor drainage makes it difficult and expensive to provide absorption fields for the septic tanks located in the rural areas which are not serviced by the town's present sewerage system. Bladenboro's storm sewer outlets do not operate effectively when floodwater builds up in the swamp adjoining the town. As the water from the storm sewers backs up, it combines with the floodwaters from drainage areas above the town, causing increased water damages.

Irrigation

Irrigation is limited almost entirely to tobacco. It is anticipated that there will be no large increase in irrigation in the future.

Municipal and Industrial Water

Municipal water for Bladenboro (population 800) comes from drilled wells. A textile plant uses water from a small tributary in its manufacturing process. Rural domestic water supplies come from shallow wells. Water

Resource Problems

for livestock is provided by small farm ponds and excavated pits. It is expected that the watershed will continue into the future as primarily an agricultural area. Based on this expectation, ground water should be sufficient to meet the future water needs of the watershed.

Recreation

Most recreational facilities in the watershed are small private lakes and farm ponds used for fishing. There are several recreational parks for team sports. Lake sites are not available for other types of water-based recreation. This type of activity is available within 20 miles of the watershed. Big Swamp offers some waterfowl hunting and excellent stream fishing. There has been no local interest shown in developing additional recreational facilities in the watershed.

Fish and Wildlife

The two primary problems relating to wildlife habitat in the watershed are lack of management and direct losses to this habitat base. There are approximately 425 acres in the lower reaches of the watershed that would, at one time, have met the requirements for classification as Type 7-Wooded Swamp (U. S. Fish and Wildlife Service Circular 39).

The basic problems relating to the fishery resource in the watershed is the limitation placed on the resource by the small stream size and low flow characteristics of Bryant Swamp Canal. Another problem is the domestic pollution from Bladenboro. However, the town is under a mandate from state authorities to modernize its sewerage treatment facilities which should help alleviate this problem. (The facilities are presently under construction.)

Economic and Social

A study of census records indicates that the number of farms in the area has decreased sharply since 1955. There has also been a corresponding increase in the size of farms during this period. This trend is primarily attributable to the cost-price squeeze that is felt more sharply in the smaller farm unit operations. Farm mechanization has also forced the consolidation of small farms into larger units. Mechanization and its accompanying improved efficiency has resulted in the displacement of many farm laborers. This problem is further aggravated by the fact that some of these displaced, underemployed laborers are untrainable and highly immobile. Many of the younger displaced residents are somewhat mobile. They migrate to larger cities before or shortly after finishing high school. Ill-prepared with the skills demanded by present day society, they perpetuate the growth of slums and blighted areas. This problem illustrates the need for more non-farm employment opportunities and the need to promote overall community development.

The so-called "family farm" is in a struggle for existence, and its death is inevitable without reduced production and harvest costs, and higher net returns. These changes must also be accompanied by a broader base of economic activity that can provide part-time employment for under-employed farmers and displaced farm laborers.

Under the domain of the Coastal Regional Commission, of which this county is a part, positive efforts are being made to reduce the out-migration from the region and to promote the balanced development of rural areas. "The primary goal of the Commission is to narrow and eventually close the gap that exists between the region's per capita income and that of the nation. The initial strategies that will be employed toward this end will involve industrial development, education and manpower training, tourist promotion, and agricultural development. Programs which may be later considered, include the region's transportation system, capital resources, and housing and health needs."^{1/}

PROJECTS OF OTHER AGENCIES

There are no known existing or soon to be constructed water resource development projects which have a direct relationship to the works of improvement included in this plan.

PROJECT FORMULATION

Numerous public meetings have been held on Bryant Swamp Watershed following a setting of priority by the N. C. Soil and Water Conservation Committee on March 8, 1967. One of the first meetings was held on April 5, 1967, to discuss the planning process and problems in the watershed. Those present included representatives from the U. S. Fish and Wildlife Service, N. C. Wildlife Resources Commission, Mayor of Bladenboro, Soil Conservation Service, and nine local citizens. Various field trips were made in the watershed with representatives from different local, state, and federal agencies.

A meeting was held with the sponsors and interested persons on November 17, 1970, to explain the review draft of the project and comments were solicited from those present.

^{1/} Hansen, Niles M., Rural Poverty and the Urban Crises, Bloomington, Indiana, 1971, p. 125

Formulation

Copies of the draft work plan were sent to concerned state agencies for their comments. A sponsoring organization was set up by the local people after some of the earlier meetings.

There are no comprehensive river basin nor resource conservation and development plans under study that cover this watershed.

Objectives

The project was formulated on the basis of objectives agreed upon with the sponsoring local organizations. These objectives are: (1) develop 57 additional conservation plans during the project installation period; (2) reduce annual soil loss on the gently sloping cropland; (3) provide adequate outlet channels for on-farm and small group drainage projects; and (4) provide protection to the crop and pasture land from the 5-year, 24-hour frequency storm.

A field survey of the watershed by the U. S. Forest Service showed that the going forestry programs in the area are adequate and that no accelerated forestry programs are needed.

Land treatment measures included in the plan were selected on the basis that they are necessary to obtain maximum benefits from proposed investments in drainage and flood prevention developments and to realize benefits used in justification of structural measures.

Environmental Considerations

There was concern shown early in the study for the possible effects a project would have on Big Swamp. These concerns were the detrimental effect on the fishery resources of Big Swamp created by sediment from cropland and channel work and domestic sewage from Bladenboro. Even though the acreage is small, it was decided to save as much of the Type 7 wetland habitat as possible. A floodway was extended down through State Road 1128 so that there would be no induced damages from the increased peaks created by the channel work. Some of the laterals were omitted during the study because of channel instability. The swamp conditions between the end of the floodway and the junction of Big Swamp will act as a filter to take out the sediment before it goes into Big Swamp.

The degree of protection given to Bladenboro will give the greatest marginal net return on the cost of improvements. The farmers will have a flood and drainage risk in line with the other risks taken in agriculture. Since the fishery resource is in the lower two miles of the main channel, stopping the channel work before getting into this area would be the least damaging to the resource. Construction methods, such as construction from on one side only, will minimize damage to existing fishery and wetland habitat. Pipes will be installed to allow water to enter the channels without serious streambank erosion. A travelway for

maintenance will be provided. The spoil and channel banks will be seeded as a part of the construction contract.

An investigation was made of a small site for a possible wildlife refuge. The investigation showed that there would be considerable expense in constructing the site to hold any water. The site was omitted because of the construction problems and the small acreage (approximately ten acres).

Alternatives

An Accelerated Land Treatment Program Only: An accelerated land treatment program without any channel work would benefit certain facets of the environment and avoid all the adverse effects. Erosion on 890 acres of crop and pasture land could be reduced within two to three years from an average of 10 tons per acre down to 6.5 tons per acre. Upland wildlife habitat should benefit as a result of the installation of practices with specific or incidental benefits to upland wildlife. Wetland wildlife habitat should not be affected. Fishery habitat should benefit as a result of a reduction of sediment being delivered to waterways. This alternative would cost \$128,900 for installation. Average annual benefits of \$550 would be realized in flood damage reduction.

The 4,090 acres of wet crop and pasture land and the town of Bladenboro would continue to have flood damage. Drainage problems caused by inadequate outlets would remain. Average annual damages from floodwater and inadequate drainage would continue at the rate of \$40,800.

Floodwater Retarding Structures: Topography of the watershed does not provide sites for construction of floodwater retarding structures with sufficient storage capacity to significantly reduce the runoff within the watershed.

System of Levees with Pumping Stations: A system of levees or dikes including pumping stations would provide flood prevention and drainage benefits to approximately 3,500 acres of wet crop and pasture land and to the town of Bladenboro. The installation of the dikes would provide incidental benefits to certain species of upland wildlife. This alternative would have no effect on the fish and wetland wildlife habitat.

The cost of this alternative was estimated at over \$800,000 installation cost and an additional \$24,000 operation and maintenance cost. It would require approximately 100 acres for rights-of-way. Installation of land treatment measures would cost an additional \$128,900. About 500 acres of crop and pasture land in small scattered tracts would not receive any flood prevention or drainage benefits. The present projected land use would not support the cost of this alternative.

Formulation

Construction of Off-Stream Channels: This alternative would involve 26.9 miles of channels including 16.9 miles of channel work on laterals. A channel would be constructed down each side of the forested flood plain from Bladenboro down to State Road 1128. This would provide floodwater and drainage benefits to the 4,090 acres of cropland. Approximately 210 acres of forestland would be cleared for rights-of-way. The depths of channels required would be from 0 - 1.5 feet deeper than the existing channel. The normal low flow would, therefore, tend to flow down the off-stream channels. This alternative would cost \$560,000 for installation. The average annual benefits would be the same as the planned project (\$72,320). Installation of land treatment measures (same as the planned project) would cost an additional \$128,900.

Clearing and Snagging: This alternative would consist of 18.9 miles of channel excavation along with clearing and snagging the existing channel from Bladenboro down to State Road 1128. This alternative would not provide the depth needed for adequate outlets for the cropland and for the town of Bladenboro. The increased side drainage associated with channels could be avoided with this alternative. This alternative would cost \$472,000 for installation. The average annual benefits are estimated to be \$62,300. Land treatment measures (same as planned project) would cost an additional \$128,900 for installation.

Do Nothing: The present going land treatment program would decrease erosion and sediment delivery. It is estimated that erosion on 890 acres of gently sloping land would be reduced to an average annual rate of 6.5 tons per acre over a period of 10 to 15 years. During this "installation" period erosion would continue to decrease suitability of these acres for row crops, and sediment would continue to be deposited in field ditches causing impaired drainage. Upland wildlife habitat would benefit as a result of the installation of land treatment practices with specific or incidental benefits to upland wildlife. Other problems, as listed under Water and Related Land Resource Problems section, would remain.

It is estimated that net annual monetary benefits of \$30,970 will be foregone if the project is not installed.

Other Considerations:

Vertical drainage wells and water-control structures have been suggested as a means of providing drainage, while at the same time, replenishing the ground water. The aquifers in Bryant Swamp are fully charged except during dry seasons. This means that a vertical drainage system could not provide drainage to the cropland when needed. The planned project will preclude the use of water-control structures at some future date to provide for complete water management in the watershed.

Flood proofing could be used in the town of Bladenboro to eliminate flood-water damages. This would involve raising all entrances to all buildings now receiving damage up to a foot in elevation. Building foundations would also need to be constructed so as to avoid seepage damage. Cropland would still receive flood and inadequate drainage damage unless this alternative was used in combination with another alternative, such as a system of levees with pumping stations.

Less intensive land use in changing from crops to pasture and forestland would lessen the needed level of protection for the present farmland. Conversion to forestland would benefit certain wildlife species, such as rabbit, squirrel, and deer. This alternative would have no effect on wetland or fishery habitat. Habitat quality for wildlife species, such as dove and quail, would be lowered. This change of land use would not fit into the economic enterprises to which the landowners are now committed. The loss of income from cropland production on the converted acres would require relocation of farm families. Bladenboro would still sustain the present flood damage.

More intensive land use would require a greater degree of protection than is needed at present. This protection would require larger channels, more cleared rights-of-way, and more construction throughout the watershed. This would adversely affect the fishery and wildlife habitat unless specific management programs were included in the alternative. This type of land use is not projected for the future.

Flood plain zoning could be used to insure that the present wetlands (Type 7) would not be cleared for crops or development in the future. This would insure the preservation of these lands for their best use. However, the legality of making the zoning ordinance retroactive to apply to the wet cropland would be highly questionable without compensation to the landowners.

Flood insurance could be made available to the people in the watershed by special legislation. It is estimated that because of the high probability of damages occurring frequently, that the average annual cost of flood and drainage insurance in this watershed would equal or exceed average annual damages. Flood insurance would, if available, leave the fish and wildlife habitat in its present state.

Public acquisition of flood prone lands would require the purchase of 4,090 acres of cropland. This would leave only 890 acres of cropland in the watershed. The cost of the land would exceed 2,000,000 dollars. Most of the people on the 140 farms would have to relocate and/or seek employment elsewhere.

Formulation

The installation cost of the project (approximately \$498,000) could be invested in securities. This would provide an average annual net income of \$180 per farm and business. Except for this net increase in income, the paying of a subsidy of this kind would be essentially the same as the do nothing alternative. There is, at present, no legislative authority which permits payments in this manner.

WORKS OF IMPROVEMENT TO BE INSTALLED

Vegetative land treatment measures to be installed will consist of 750 acres of conservation cropping systems; 640 acres of crop residue use; 100 acres of cover crops; 1,300 feet of field border plants; and 70 acres of minimum tillage. Forty acres of cleared rights-of-way will be planted to vegetation suitable for wildlife food and cover.

There will be 830 acres of cropland treated with structural land treatment measures, such as 13,500 feet of surface drains; 17,500 feet of tile drains; 140 acres of land smoothing; and 1,000 feet of diversions.

The vegetative and structural land treatment measures are estimates, considering installation problems discussed under Water and Related Land Resource Problems, that can be installed, during the five-year installation period of the project.

Structural works of improvement consist of approximately 22.9 miles of stream channel work for flood prevention and drainage and six grade-control structures.

Road modifications include six streets in the town of Bladenboro, 23 public roads, 20 private roads, and three railroads. Most of the modifications will involve a grade-control drop of 0.5 to 2.0 feet. The grade-control drops at road crossings will permit channel bottoms to be constructed with flatter slopes and thereby insure stability of the channels.

Because of the steep grade, a grade-control structure will be required on Lateral No. 6 to insure a stable channel. Similar structures will be used, as needed, at the upper end of other laterals to stabilize the inlet into the new channel (see project map). Sand-cement bag riprap will be used to protect and stabilize the structures.

Of the 22.9 miles of channel work, 17.67 miles will be in previously modified channels and 5.23 miles will be in areas that have no existing defined channels.

Spoil material excavated from the channel will be placed on one side of all channels and will be utilized as a maintenance travelway. The

travelway will not be continuous but will be accessible by private and public roads. Spoil disposal areas not used by the travelway will be seeded to vegetation suitable for wildlife food and cover. The travelway will be seeded to permanent grass. Pipe inlets are planned, as needed, to allow surface water to enter the channels without erosion and to provide a travelway for maintenance.

The effects of sediment created during construction will be reduced by the installation of sediment traps on the main channel between Bladenboro and the end of the channel work. The trap at the end of construction will be constructed first, and each succeeding trap will be constructed as channel work progresses to that location. These traps will be cleaned out, as needed, during and immediately after construction. They will also be cleaned out, as needed, as part of maintenance performed by the sponsors. The need for cleaning is established as the time when the volume has been reduced to 20 percent of the original.

From Station 338+50 to Station 418+00 (see project map) works of improvement will consist of a floodway. This floodway will provide an adequate outlet for the increased peaks and decreased duration of flow caused by the project to a point where there will be no damage. Excavation of the floodway will be limited to that needed to remove trees, roots, and channel blocks within the 34-foot width. The width selected for the floodway is the approximate top width of the existing channel. The existing spoil on the north side of the channel will be shaped to form a travelway for maintenance. Construction will be from the north side to permit using the shade from the south side to reduce the need for future maintenance and to maintain existing stream overhead cover.

The estimated total installation cost for all land treatment measures is \$128,900. Installation cost of structural measures is estimated to be \$498,000.

EXPLANATION OF INSTALLATION COSTS

Land Treatment

The entire land treatment program is estimated to cost \$128,900. Of this amount, \$45,000 will be contributed under authority of Public Law 566 and \$83,900 will be contributed by other funds.

The Soil Conservation Service will provide accelerated technical assistance valued at \$45,000. Other going programs will provide accelerated technical assistance valued at \$13,800. Private landowners and operators will provide \$70,100 for the installation of conservation measures on their land.

Costs

The going Cooperative Forest Management Program will provide services valued at \$1,500 and the going Cooperative Forest Fire Control Program will provide a capital outlay of \$6,800 for the fire control activities during the installation period.

Structural Measures

The construction cost of each structural measure is the estimated cost of all materials, labor and equipment included in their construction. Included in the construction cost is a contingency allowance of 15 percent to cover unforeseen items of construction. No unusual construction problems are anticipated during final design.

Cost-sharing items for the 22.9 miles of stream channel work include 120,400 cubic yards of channel excavation (\$60,175); 185 acres of clearing (\$92,650); 1.5 miles of clearing and snagging (\$11,400); and 256 pipe inlets (\$57,470). There will also be three railroad modifications (\$7,620) and 70 acres of spoil established to vegetation (\$42,060). Six grade-control structures to hold velocities within allowable limits are estimated at \$9,000.

Land rights include 11 acres of open land and 256 acres of forestland valued at \$41,000; 20 farm road modifications at a cost of \$19,000; and 29 public road modifications, including six city streets, at a cost of \$39,000.

Installation cost of structural measures is estimated to be \$498,000. It consists of \$300,000 construction cost (including a 15-percent contingency allowance); engineering services (\$30,000); project administration (\$46,000); and land rights cost (\$101,000). Engineering services cost is for surveys, designs, and construction layout. Project administration costs cover such items as construction inspection, administration overhead and administration of contracts. Land rights cost includes road modifications and cost or value of acquiring land, easements, and rights-of-way. It is anticipated that there will be no relocation payments involved in the structural measures.

Cost-sharing was arrived at by first allocating the cost of the multiple-purpose channel work to flood prevention in the same ratio of non-wetland to total area served by the channel. The remaining cost was considered as a joint cost and was allocated equally between flood prevention and drainage. The amount of \$239,560 (53 percent) was allocated to flood prevention and \$212,444 (47 percent) was allocated to drainage. Of the cost allocated to flood prevention, \$186,030 will be from Public Law 566 funds and \$53,530 will be from other funds. Cost allocated to drainage will be shared \$89,535 from Public Law 566 and \$122,905 from other funds.

The estimated total Public Law 566 and other obligations for each fiscal year during the installation period are as follows:

CostsLand Treatment

<u>Year</u>	<u>P. L. 566</u>	<u>Other</u>	<u>Total</u>
First	\$ 5,000	\$10,400	\$ 15,400
Second	7,000	15,000	22,000
Third	11,000	19,500	30,500
Fourth	11,000	19,500	30,500
Fifth	11,000	19,500	30,500
Total	\$45,000	\$83,900	\$128,900

Structural Measures

<u>Year</u>	<u>P. L. 566</u>	<u>Other</u>	<u>Total</u>
First	\$ 30,000	\$ 76,000	\$106,000
Second	278,000	93,000	371,000
Third	11,565	9,435	21,000
Total	\$319,565	\$178,435	\$498,000

EFFECTS OF WORKS OF IMPROVEMENTFlood Prevention, Erosion, and Sediment

The project will provide protection from the five-year frequency storm. Storms of greater magnitude than the five-year frequency will cause some flooding; however, the reduction in degree and duration will materially reduce flood damages for these larger storms.

For the five-year frequency storm, channel work will cause an increase in the peak (maximum discharge in cubic feet per second) but a decrease in stage (elevations) at the junction of the main and Lateral No. 7. The peak for this storm will increase by 25 percent, while the stage will be 1.6 feet (19 inches) lower.

For the same storm there will be an increase in the peak and stage at the end of the channel work. The peak will be increased by 34 percent and the stage will increase by 0.4 foot (five inches). This increase will not cause any downstream damage. Bryant Swamp has five percent of the drainage area of Big Swamp and the length of the watercourse is approximately 20 percent; therefore the increase in peak and stage would have no effect on flood peaks or stages in Big Swamp.

The average annual flood damages in Bladenboro will be reduced approximately 38 percent; but the degree of protection will not eliminate damages to present development. Future development will be limited in the area outlined by the flood plain map. This map will be published locally by the sponsors, at least annually, to inform the local people of the remaining flood hazard.

Effects

Flooding in the residential areas will be confined to shallow flooding of lawns and some storage buildings for the 100-year frequency storm, however, a few businesses will still experience flooding a few inches deep for the same storm.

The forested flood plain will still be flooded frequently. It is not anticipated that the use of this land or any other land will change as a result of this project.

Agricultural floodwater damages will be reduced 83 percent; while the non-agricultural damages will be reduced 38 percent. Flooding will be reduced on 4,090 acres of crop and pasture land. Floodwater damages to 22 stores and/or businesses will be reduced by the project. All of the 140 farms in the watershed will receive increased income from the project's installation and operation.

Erosion from the 890 acres of land with sheet erosion problems will be reduced by 2,900 tons annually. (A reduction of 35 percent.)

The average annual concentration of sediment entering Big Swamp is expected to be 13 mg/l for a period of one year during and immediately following construction of the project. This concentration level will decrease over a period of two to three years until the channel becomes stabilized. It is estimated that the future average annual concentration will level off at 8 mg/l. Studies, as reported in The Practice of Water Pollution Biology, 1969 article by the Federal Water Pollution Control Administration, indicate no harmful effects to the fishery resource for normal sediment concentration levels up to 25 mg/l. The estimated increase in average annual sediment concentration from 5 mg/l to 8 mg/l will increase the sediment concentration in Big Swamp by 0.15 mg/l. It is anticipated that this 0.15 mg/l would be immeasurable as far as any effect on the fishery of Big Swamp.

Existing information indicates that the ground water aquifer in Bryant Swamp is fully charged except for short periods during the dry seasons.

The proposed main channel will follow the existing channel and will be from 4 feet deeper at the upper end to 0 - 1.5 feet deeper from Bladenboro down to the end of construction. Any effect of the project on ground water will be confined to 1.5 - 4 feet below the surface. Ground water will be lowered at the channel by the depth of excavation. The effect will lessen to zero feet a few hundred feet from the channel.

On-farm drainage will affect the cropland in the same manner for the depth of the open drain or field tile. The large, forested recharge areas will remain in their present state. The system of proposed channels will allow water-control structures to be installed in the future if and when they are deemed necessary or desirable.

Agricultural Water Management

Local farm operators and landowners anticipate improved quality of crops because the installation of the project will enable producers to harvest before quality can be affected by the weather and other factors. They do expect increased yields in most crops as a result of the better utilization of fertilizer and other management factors.

The 4,090 acres of crop and pasture land benefited from flood prevention will also benefit from improved outlets for drainage. Adequate drainage of surface water will prevent stagnant water accumulation, thereby lessening the pollution problems associated with odor nuisances, fly and mosquito breeding areas and spread of human diseases.

Fish and Wildlife and Recreation

Fishery resources within the watershed vary greatly according to specific stream reaches. For the purposes of evaluating project impacts on these resources, the stream should be subdivided as follows:

A. Steam reach from Bladenboro downstream to State Road 1178:

In this reach, stream fishery resource values are low with domestic and industrial pollution currently being the primary limiting factors. However, stream size and water flows are of such low size and magnitude that even after the installation of a treatment plant (first phase of completion-June 1974) at Bladenboro stream fishery resources in this reach will remain of low value. This is due to the normal pollution effects associated with a town or urban area located on a small stream.

B. Stream reach from State Road 1178 downstream to Big Swamp:

In evaluating the effects of works of improvement on fishery resources in this reach, it is of critical importance to recognize the type of works planned; i.e., a floodway in which no excavation is planned and in which the overhead cover is left intact on the south side. This will be approximately 1.5 miles down to State Road 1128. Below State Road 1128, no works of improvement are planned. Since only a limited amount of construction will be carried out in this reach, the effects on fishery resources are expected to be minimal.

C. Big Swamp:

The potential effects of the project on Big Swamp would be increased sediment and possibly an increase of polluted waters reaching Big Swamp proper. The installation of sediment traps, the distance between Big Swamp and the upstream termination point (State Road 1128),

Effects

and the distance between the pollution source and Big Swamp, are factors which will minimize project effects on this reach. Comparative size of the drainage areas is also an important factor in the project's downstream effects. Bryant Swamp makes up 5.8 percent of Big Swamp and 1.7 percent of the Lumber River. Assuming that any increase in such factors as sediment or nitrates were delivered in total to these streams, it would require a 17 mg/l increase in Bryant Swamp to cause a 1 mg/l increase in Big Swamp. By the same reasoning, it would require a 59 mg/l increase in Bryant Swamp to produce a 1 mg/l increase in the Lumber River. Any predictable changes in Bryant Swamp, as a result of the project, would be considerably less than these amounts. (The 3 mg/l increase in sediment would cause a 0.15 mg/l increase in Big Swamp and a 0.05 mg/l increase in the Lumber River) Based on these conclusions, the project would have no measurable effect on Big Swamp.

Maintenance of the sediment traps will cause an increase in turbidity for a short time immediately below each trap. Because of the type of sediment being disturbed (coarse fraction), it is expected to settle out quickly, and will have no effect downstream as far as Big Swamp.

Approximately 25 acres of wetland habitat in the lower reach of the project will not be affected to a significant degree since only a floodway is planned for the reach. These 25 acres are randomly scattered along the channel proper. Peak flows, which will be increased somewhat in the area of the floodway, should increase flooding on the adjacent wetlands in this lower reach. Fifty acres of wetland habitat in and near Bladenboro will be lost or will have a reduced value as wetland habitat as a result of channel work.

Archaeological, Historical, and Scientific

There are no properties listed in the National Register of Historic Places. There are no known places with archaeological or historical values located in the watershed.

Economic and Social

Increased economic activity caused by the project will create eight new jobs for the entire project life. This includes two part-time (half-time) workers needed to operate and maintain the project. Construction funds, in the form of wage payments, will create 12 new jobs during the period of construction.

Income in the area will increase as a result of the project's installation. Farmers' and farm operators' net income will increase approximately \$39,410 annually. Local non-farm workers will receive \$60,000 in the form of wage payments during the period of project construction. Approximately \$6,000 will also be paid in the form of wages for operation and maintenance of the project.

Other

There will be 186 acres of forestland and 15 acres of cropland required for the rights-of-way of the project. The 15 acres of cropland will be returned to cropland immediately after construction. Ninety acres of the forestland required for rights-of-way will be used for debris disposal. As the debris decays, this land will gradually revert to forestland. Increased channel widths will require 16 acres of the forestland. Spoil will be spread on the remaining 80 acres of forestland. Approximately 40 acres of this spoil area will be seeded to permanent vegetation and will be used as access roads. The remaining 40 acres will be planted to vegetation suitable for wildlife food and cover, such as shrub lespedeza.

Construction methods, such as sediment traps, immediate seeding of temporary vegetation, and reducing the time between construction and seeding of permanent vegetation, will be used to reduce the construction effect of sediment delivery to downstream flood plain areas and Big Swamp.

PROJECT BENEFITS

Total average annual benefits from structural measures are estimated to be \$72,320. These consist of \$33,890 flood prevention benefits, \$20,680 drainage benefits, \$11,700 secondary, and \$6,050 redevelopment benefits (Table 6).

Flood prevention benefits will accrue as a result of reduction of flood damage to crops and pasture, urban property, and public roads and bridges. Drainage benefits will accrue in the form of increased net returns resulting from improved efficiency of farming. This includes more efficient use of machinery, optimum performance of cultural and harvesting operations, and higher prices of farm products because of better quality.

Secondary benefits will accrue to processors, handlers, and local businesses in the immediate area as a result of increased farm income in the watershed. Additional secondary benefits of a less tangible nature are expected to accrue outside the immediate area of influence of the project. They will accrue to beneficiaries not readily identifiable and are more in the nature of benefits to the public in general. These benefits were not considered pertinent to economic evaluation of the project.

Redevelopment benefits will result from income provided to unemployed and underemployed labor and use of other resources required for project construction, project operation and maintenance, and added area employment during the project life.

COMPARISON OF BENEFITS AND COSTS

The average annual cost of structural measures including annual operation and maintenance is estimated to be \$41,350. Estimated average annual benefits are \$72,320. This results in a benefit-cost ratio of 1.7 to 1.0 (Table 6). The benefit-cost ratio, excluding secondary benefits, is 1.5 to 1.0.

PROJECT INSTALLATION

The Bryant Swamp Flood Control Corporation was established under provisions of Chapter 156 of the General Statutes of North Carolina "for the purpose of constructing and maintaining a canal and laterals on Bryant Swamp in Bladen County." The Corporation has been designated by the sponsors to work with the Service during construction of the structural measures. These measures will be installed under a contract administered by the Bryant Swamp Flood Control Corporation.

All land rights will be acquired by the Corporation before Public Law 566 assistance will be available for construction.

Landowners will install the planned land treatment measures in accordance with provisions of their individual conservation plans and agreements with the Bladen Soil and Water Conservation District.

Technical assistance, including needed soil surveys, will be provided by the Service through the soil and water conservation district program. The present rate of assistance will be supplemented under provisions of Public Law 566 to accelerate planning and installation of land treatment measures so that the project can be completed during the five-year installation period.

The Corporation officials have already completed arrangements with the N. C. Division of Transportation and Highway Safety so they can make the necessary changes to public road structures and features related thereto. They have also completed arrangements with the town of Bladenboro for changes to street culverts along channels passing through town.

Private road crossing modifications will be included as a part of the construction contract for structural measures. Seaboard Coast Line Railroad officials will be notified prior to construction reaching the railroad modifications.

Engineering services, including surveys, investigations, design, and preparation of plans and specifications, for the structural measures will be furnished by the Service under provisions of Public Law 566.

Project administration to be furnished by the Service will include Government representatives and necessary construction inspection to insure compliance with the plans and specifications. The portion of the project administration to be provided by the Bryant Swamp Flood Control Corporation will be the cost of administering the contract.

It is anticipated that the project will cause no displacement of any person, business, or farm operation.

As co-sponsor, the Bladen Soil and Water Conservation District will provide such assistance and guidance as necessary to expedite co-ordination between land treatment and structural measures.

FINANCING PROJECT ADMINISTRATION

Cost of installing land treatment measures will be provided by individual landowners concerned. The major portion of the landowners' cost will be in the form of value of labor and use of farm equipment. Cost of technical assistance will be provided by the Service. The present rate of assistance through the soil and water conservation district going program will be continued. Cost of accelerated technical assistance will be paid from Public Law 566 funds.

The going Cooperative Forest Management Program will provide services valued at \$1,500 to landowners and operators during the project installation period. The going Cooperative Forest Fire Control Program will provide services valued at \$6,800 during the installation period.

The part of installation costs of structural measures to be borne by the federal government will be furnished by the Service under provisions of Public Law 566. Financial and other assistance to be furnished by the Service in carrying out the project is contingent on appropriation of funds for this purpose.

All funds necessary to cover organizational cost, operational expenses, land rights cost, cost of administering contracts, and the local organization's share of construction cost will be furnished by the Bryant Swamp Flood Control Corporation. The Corporation has already raised, and has on hand, funds to cover its share of costs.

Prior to entering into agreements that obligate funds of the Service, the Bryant Swamp Flood Control Corporation will have a financial management system for control, accountability, and disclosure of Public Law 566 funds received, and for control and accountability for property and other assets purchased with Public Law 566 funds.

Program income earned during the grant period will be reported on the sponsor's request for advance or reimbursement from the Service.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by landowners concerned in accordance with their individual soil and water conservation plans. The Bladen Soil and Water Conservation District Supervisors will make an annual review of land treatment installed to determine the status of maintenance, and will put special emphasis where needed to insure a continuing high level of land treatment for protection of the watershed.

The North Carolina Office of Forest Resources will continue to furnish management assistance to landowners through the going Cooperative Forest Management Program, and fire control activities through the going Cooperative Forest Fire Control Program.

Structural measures to be maintained consist of 22.9 miles (121,000 linear feet) of channel work and six grade-control structures. Maintenance will be performed by the Bryant Swamp Flood Control Corporation. Funds to cover maintenance cost will be provided through assessments to landowners in the watershed, as provided by the Court's confirmation of incorporation. The cost is estimated to average \$12,000 annually.

Maintenance work likely to be needed will consist of, but not limited to:

1. Removal of debris from channels and intake end of pipes through spoil following major storms.
2. Control of vegetative growth along and adjacent to channels.
3. Control of aquatic plants in channel bottoms.
4. Periodic removal of sandbars from channels.
5. Mowing of seeded portion of spoil at least once each year.
6. Remove sediment from sediment traps as needed.

It may also be necessary to employ a dragline to excavate sediment accumulation from channels throughout the entire system every 15 years to 20 years.

Maintenance requirements are likely to be greater during the first two or three years while channel banks are becoming stabilized. Some sloughing may occur and corrective action will be taken promptly to prevent rapid deterioration of channels. Careful attention to maintenance during the first few years will lessen maintenance cost over the remaining life of the project.

Representatives of the Service and Bryant Swamp Flood Control Corporation will make a joint inspection of channels annually or after unusually severe floods. A report of each inspection will be prepared by the Corporation. A copy of each report will be furnished to the Service representative who will review reports and inform the state conservationist of any measures needing corrective action.

Specific operation and maintenance agreements will be executed between the Service and the Bryant Swamp Flood Control Corporation prior to signing the project agreement. The North Carolina Watershed Operation and Maintenance Handbook will be used as a guide to prepare an operation and maintenance plan on each structural measure.

The operation and maintenance agreement will include specific provisions for retention and disposal of property acquired or improved with Public Law 566 financial assistance.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Bryant Swamp Watershed
Bladen County, North Carolina

	:	:	:	Estimated	Cost	Dollars ^{1/}	:
	:	:	:				:
	:	:Non-	:	P.L. 566	:	Other	:
	:	:Federal	:	Non-Federal	:	Land	:
Installation Cost Item	:Unit	:Land	:	SCS ^{2/}	:	SCS ^{2/} : FS ^{2/}	:
							Total
<u>LAND TREATMENT</u>							
Land Areas ^{3/}							
Cropland	Acres	830		26,400			26,400
Grassland	to be	500		40,300			40,300
Other Land	Treated	35		3,400			3,400
Going Cooperative Forest Management Program						1,500	1,500
Going Cooperative Forest Fire Control Program						6,800	6,800
Technical Assistance			45,000	5,500			50,500
TOTAL LAND TREATMENT			45,000	75,600	8,300		128,900
<u>STRUCTURAL MEASURES</u>							
<u>Construction</u>							
Channel Modification ^{4/}	Miles						
(M)		17.67	186,800	57,382			244,182
(O)		5.23	51,880	15,938			67,818
Grade Control Structures	No.	6	6,885	2,115			9,000
Subtotal-Construction			245,565	75,435			321,000
Engineering Services			30,000				30,000
<u>Project Administration</u>							
Construction Inspection			29,000				29,000
Other			15,000	2,000			17,000
Subtotal-Administration			44,000	2,000			46,000
<u>Other Costs</u>							
Land Rights				101,000			101,000
TOTAL STRUCTURAL MEASURES			319,565	178,435			498,000
TOTAL PROJECT			364,565	254,035	8,300		626,900

^{1/} Price base: 1974

^{2/} Federal agency responsible for assisting in installation of works of improvement.

^{3/} Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed and dollar amounts apply to total land areas.

^{4/} Type of channel before project: (M) - manmade ditch or previously modified channel
(O) - none or practically no defined channel

Date: August 1974

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at time of Work Plan Preparation)

Bryant Swamp Watershed
Bladen County, North Carolina

	:	:	:	Total
	:	:	Applied	Cost
Measures	Unit	To Date	Dollars	^{1/}
<u>Land Treatment</u>				
Conservation Cropping Systems	Acre	1,715		4,290
Crop Residue Management	Acre	1,045		3,135
Contour Farming	Acre	50		150
Field Border	Feet	2,000		200
Grassed Waterway or Outlet	Acre	5		500
Terracing	Feet	5,000		200
Drainage Main or Lateral	Feet	20,000		5,000
Drainage Field Ditch	Feet	5,280		790
Drain	Feet	50,000		18,000
Pasture and Hay Management	Acre	425		17,000
Pasture and Hay Planting	Acre	425		34,000
Wildlife Habitat Management	Acre	8		160
Ponds	No.	15		4,500
Tree Planting	Acre	100		3,000
Timber Stand Improvement	Acre	85		2,200
Improvement Cutting	Acre	1,120		1,200
<u>Total</u>				<u>94,325</u>

1/ Price base: 1974

Date: August 1974 .

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION

Bryant Swamp Watershed
Bladen County, North Carolina

(Dollars)^{1/}

Item	: Installation Cost - P. L. 566			: Installation Cost - Other			: Total
	: Con- struction ^{2/}	: Engi- neering	: Total : P. L. 566	: Con- struction ^{2/}	: Land : Rights	: Total : Other	: Installation : Cost
<u>Channel Modification:</u>							
Main							
100+00-169+50 (O) ^{4/}	22,185	2,700	24,885	6,815	4,400	11,215	36,100
169+50-418+00 (M)	66,839	7,900	74,739	20,531	13,200	33,731	108,470
Lateral 2							
26+50- 91+00 (O)	8,169	1,000	9,169	2,509	4,200	6,709	15,878
91+00-163+50 (M)	9,212	1,100	10,312	2,830	4,900	7,730	18,042
Lateral 3							
53+00-197+50 (M)	22,881	2,700	25,581	7,029	12,700	19,729	45,310
Lateral 3A							
53+25-115+25 (M)	9,677	1,200	10,877	2,973	2,500	5,473	16,350
Lateral 6							
50+00-151+75 (M)	16,157	1,900	18,057	4,963	7,600	12,563	30,620
Lateral 6A							
57+50- 91+75 (O)	5,760	700	6,460	1,770	2,200	3,970	10,430
Lateral 6C							
50+00- 57+00 (M)	1,163	200	1,363	357	200	557	1,920
Lateral 7							
48+50- 78+00 (O)	3,894	500	4,394	1,196	2,300	3,496	7,890
78+00-116+00 (M)	13,640	1,700	15,340	4,190	20,900	25,090	40,430
Lateral 8							
57+00- 85+00 (M)	5,125	700	5,825	1,575	3,100	4,675	10,500
Lateral 8A							
55+75- 60+75 (M)	1,354	200	1,554	416	300	716	2,270
Lateral 11							
44+00-101+75 (O)	8,874	1,100	9,974	2,726	5,500	8,226	18,200
101+75-182+50 (M)	13,319	1,600	14,919	4,091	7,600	11,691	26,610
Lateral 11A							
50+00- 73+50 (M)	4,261	600	4,861	1,309	3,200	4,509	9,370
Lateral 11B							
17+00- 61+75 (M)	7,306	900	8,206	2,244	2,000	4,244	12,450
Lateral 12							
61+50- 66+00 (O)	696	100	796	214	200	414	1,210
66+00- 86+75 (M)	4,820	600	5,420	1,480	700	2,180	7,600
Lateral 13							
47+50- 85+00 (M)	5,492	700	6,192	1,688	500	2,188	8,380
Lateral 14							
50+00- 55+00 (O)	2,302	300	2,602	708	1,400	2,108	4,710
Lateral 15							
50+00- 78+50 (M)	5,554	700	6,254	1,706	1,400	3,106	9,360
Grade Control Structures	6,885	900	7,785	2,115		2,115	9,900
Subtotal	245,565	30,000	275,565	75,435	101,000	176,435	452,000
Project Administration	xxxxxxx	xxxxxx	44,000	xxxxxxx	xxxxxxx	2,000	46,000
GRAND TOTAL	245,565	30,000	319,565	75,435	101,000	178,435	498,000

^{1/} Price base: 1974^{2/} Includes railroad modification - \$5,829 P. L. 566 and \$1,791 other funds^{3/} Road modifications - \$42,250 public roads; \$20,250 private roads^{4/} Type of channel before project: (M) - man-made ditch or previously modified channel
(O) - none or practically no defined channel

Date: August 1974

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Bryant Swamp Watershed
Bladen County, North Carolina

(Dollars) $\frac{1}{-}$

Item	COST		ALLOCATION		COST		SHARING	
	PURPOSE				P. L. 566		Other	
	Flood	:	Flood	:	Flood	:	Flood	:
	Prevention:	Drainage:	Total	:	Prevention:	Drainage:	Total	:
Stream Channel Work	234,313	207,787	442,100	180,783	86,997	267,780	53,530	120,790
Grade Control Structures	5,247	4,657	9,900	5,247	2,538	7,785	0	2,115
Total	239,560	212,444	452,000	186,030	89,535	275,565	53,530	122,905
								176,435

$\frac{1}{-}$ Price base: 1974

Date: August 1974

TABLE 3 - STRUCTURE DATA
CHANNELSBryant Swamp Watershed
Bladen County, North Carolina

Channel (No. or Name)	Sta. Numbering for Reach	Drainage Area : Sq. Mi.	Capacity cfs	Water : Surface Elevation : (ft)	Hydraulic Gradient : (ft/ft)	Channel Dim. : 1/ Bottom : (ft)	Value : 2/ Aged	Velocities : 3/ Aged : fps	Excava- tion : Cu. Yds.	Type of Work	Before Type of Channel	Project Flow Conditions
Bryant Swamp Main	100+00 123+50 123+50 169+50 169+50 210+00 210+00 244+00 244+00 266+00 266+00 338+50	6.10 6.90 10.50 12.10 14.10 16.60	230 254 366 411 466 533	106.6 103.4 102.0 101.0 100.0 96.7	.00070 .00070 .00035 .00030 .00045 .00045	16 18 24 24 24 24	.040 .040 .035 .035 .035 .035	2.26 3.61 2.30 3.69 2.13 2.99 2.05 2.87 2.51 3.52 2.57 3.61		II II II II II II	0 0 M (1935) M (1935) M (1935) M (1935)	PR PR PR PR PR PR
Main-34' Floodway	338+50 418+00	24.90		91.8	.00060	5400				III	M (1935)	PR
Lateral No. 2	26+50 91+00 91+00 163+50	1.06 2.31	54 102	109.7 96.6	.00130 .00170	4 4	.045 .045	2.17 3.89 2.49 4.48	3,100	II II	0 M (U)	E E
Lateral No. 3	58+00 96+25 96+25 164+00 164+00 197+50	0.40 1.90 2.00	30 96 96	112.3 99.5 96.1	.00250 .00160 .00100	4 4 5	.045 .045 .040	2.70 4.84 2.41 4.36 2.22 3.55	11,800	II II II	M (U) M (U) M (U)	E E E
Lateral No. 3A	53+25 115+25	0.80	42	104.0	.00250	4	.045	2.70 4.84	3,500	II	M (U)	E
Lateral No. 6	50+00 98+50 98+50 119+25 119+25 141+75 141+75 151+75	0.61 1.72 1.88 1.93	40 79 85 87	115.2 109.0 104.1 101.0	.00250 .00250 .00150 .00180	4 4 4 4	.045 .045 .045 .045	2.70 4.84 2.70 4.84 2.34 4.22 2.56 4.61		II II II II	M (U) M (U) M (U) M (U)	E E E E
Lateral No. 6A	57+50 91+75	0.72	42	118.3	.00250	4	.045	2.70 4.84	1,000	I	0	E
Lateral No. 6C	50+00 57+00	0.07	6	128.0	.00250	4	.045	2.70 4.84	1,100	II	M (U)	E
Lateral No. 7	46+50 78+00 78+00 116+00	0.60 1.33	40 64	113.4 102.7	.00250 .00150	4 4	.045 .045	2.70 4.84 2.34 4.22	3,600	I II	0 M (U)	E E
Lateral No. 8	57+00 85+00	0.57	38	104.0	.00250	4	.045	2.70 4.84	1,500	II	M (U)	E
Lateral No. 8A	55+75 60+75	0.16	12	108.3	.00250	4	.045	2.70 4.84	700	II	M (U)	E
Lateral No. 11	44+00 101+75 101+75 182+50	0.79 2.50	42 108	117.3 103.4	.00140 .00160	4 4	.045 .045	2.00 3.13 2.40 4.35	9,600	I II	0 M (U)	E I

CONTINUED ON NEXT PAGE

TABLE 3 - STRUCTURE DATA (Cont)
CHANNELS

Bryant Swamp Watershed
Bladen County, North Carolina

Channel (No. or Name)	Sta. No.	Sta. for Reach	Sta. No.	Drainage Area :Sq. Mi.	Capacity :cfs	Design :Design	Water Surface Elev. : (ft/ft)	Hydraulic Gradient : (ft/ft)	Channel		Aged : (ft)	Velocities		Excava- tion :Cu. Yds.	Type of Work	Before Type of Channel	Project Flow Condition
									Dim. :1/ :Bottom :Depth : (ft)	2/ :Aged :fps		3/ :Aged :fps					
Lateral No. 11A	50+00	73+50	0.61	40	71	108.9	.00170	4	4.0	.045	2.22	3.98	900	II	M (U)	E	
Lateral No. 11B	17+00	61+75	0.36	26	105	114.0	.00150	4	5.0	.045	2.34	4.22	1,500	II	M (U)	E	
Lateral No. 12	61+50 66+00	66+00 86+75	0.05 0.34	4 26	109 86	121.0 110.0	.00400 .00250	4 4	4.0 4.0	.045 .045	3.40 2.70	4.74 4.84	2,900	I II	0 M (1968)	E E	
Lateral No. 13	47+50 72+00	72+00 85+00	0.22 0.24	16 18	42 77	110.0 104.5	.00060 .00200	4 4	4.0 4.0	.045 .045	1.32 2.42	2.37 4.33	2,800	II II	M (U) M (U)	E E	
Lateral No. 14	50+00	55+00	0.10	8	67	101.8	.00060	4	5.0	.045	1.48	2.67	2,500	I	0	E	
Lateral No. 15	50+00	78+50	0.30	22	105	107.3	.00150	4	5.0	.045	2.34	4.22	4,800	I	M (U)	E	

- 1/ All side slopes are 1:1
2/ As built "n" value = .025 for all channels
3/ As built velocities taken at bankful or 10-year peak, whichever is smaller
4/ I - Establishment of new channel including necessary stabilization measures
II - Enlargement of existing channel or stream
III - Cleaning out natural or manmade channel (includes bar removal and major clearing and snagging operations)
5/ M () - Manmade ditch or previously modified channel (Approximate date or date unknown of original major construction in parenthesis)
0 - None or practically no defined channel
6/ PR - Perennial - flows at all times except during extreme drought
I - Intermittent - continuous flow through some seasons of the year, but little or no flow through other seasons
E - Ephemeral - flows only during periods of surface runoff
7/ Channel dimensions for the floodway are the cross-sectional area and wetted perimeter below the hydraulic grade line

Date: August 1974

TABLE 3A - STRUCTURAL DATA
GRADE STABILIZATION STRUCTURES

Bryant Swamp Watershed
Bladen County, North Carolina

Structure	Drainage	Design Capacity	Drop	Type of Structure
Location	Area	$\frac{1}{\text{CFS}}$	(Ft.)	
	(Sq. Mi.)	(CFS)	(Ft.)	
<u>Lateral No.</u>				
3	0.43	70	3.0	Straight Drop Spillway
6	0.56	80	3.0	Straight Drop Spillway
6A	0.40	65	2.7	Straight Drop Spillway
11	0.79	115	3.3	Straight Drop Spillway
11B	0.36	60	3.0	Straight Drop Spillway
12	0.05	18	4.0	Straight Drop Spillway

1/ Based on peak flow for five-year frequency storm

Date: August 1974

TABLE 4 - ANNUAL COST

Bryant Swamp Watershed
Bladen County, North Carolina

(Dollars)^{1/}

Evaluation Unit	: Amortization of Installation Cost ^{2/}	: Operation and Maintenance Cost	: Total
Stream Channel Work and Grade-Control Structures	26,650	12,000	38,650
Project Administration	2,700	xxxxxxx	2,700
Total	29,350	12,000	41,350

^{1/} Price base: Installation Cost - 1974 Prices
Operation and Maintenance - Adjusted Normalized

^{2/} Amortized at 5 7/8 percent interest rate for 50 years.

Date: August 1974

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Bryant Swamp Watershed
Bladen County, North Carolina

(Dollars)^{1/}

Item	: Estimated Average Annual Damage :			Damage
	: Without	:	With	: Reduction ,
	: Project	:	Project	: Benefits
Floodwater				
Crop & Pasture	26,500		3,180	23,320
Non-agricultural				
Public Roads & Bridges	1,990		240	1,750
Commercial	8,100		2,600	5,500
Subtotal	36,590		6,020	30,570
Indirect	4,768		898	3,870
Total	41,358		6,918	34,440

^{1/} Price base: Adjusted Normalized and 1974

Date: August 1974

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Bryant Swamp Watershed
Bladen County, North Carolina

(Dollars)

Evaluation Unit	AVERAGE	BENEFITS		ANNUAL	Reduction	Drainage	Secondary	Redevelopment	Total	Average Annual Cost ^{3/}	Benefit Cost Ratio
		1/	2/								
Stream Channel Work	33,890	20,680	11,700	6,050	72,320	38,650	1.9:1.0				
Project Administration	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	2,700	xxxxxx				
Total	33,890 ^{4/}	20,680	11,700	6,050	72,320	41,350	1.7:1.0				

1/ Price base: 1974 prices for all values except agricultural products which are adjusted normalized.

2/ Based on 5 7/8 percent interest rate.

3/ From Table 4

4/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$550 annually

Date: August 1974

INVESTIGATIONS AND ANALYSES

Land Use and Treatment

Present land use was determined from soil surveys, soil and water conservation district reports, and field studies. Estimates of future land use and treatment measures were made by the district conservationist on the basis of his knowledge of the land, people, and trends in the watershed area. Needed land use adjustments based on land capabilities were considered in arriving at the land treatment measures planned for the watershed.

The importance of land treatment has been stressed in every meeting with the sponsoring local organization. Every effort has been made to make them aware that benefits claimed for project justification are contingent upon the application of land treatment measures.

Forestry

A systematic field survey made by the U. S. Forest Service showed ground cover, forest conditions, and land treatment needs. This survey, supporting data, and information from other forestry officials determined the amount of remedial measures.

Engineering

A thorough field inspection was made of the drainage facilities in the watershed. Existing channels are of inadequate capacity because of siltation, woody growth, and debris. The upper end of the watershed (from N. C. 211 upstream) appears never to have had any channel work.

Field surveys were made, using mean sea level as datum, of: (1) representative cross sections of channels proposed for modification; (2) essential data pertaining to all bridges and culverts; and (3) cropland elevation. These data were used to prepare channel profiles to facilitate hydraulic design, estimate quantity of earth excavation, and determine road structure modifications. All land areas and horizontal distances for the watershed were measured from a semi-controlled aerial photo mosaic.

The rainfall-runoff relationship was determined for the watershed using soil cover complex data. Using this relationship and N. C. rainfall curves, runoff from the 5-year, 24-hour frequency storm was determined. A coefficient "C" value of 51 was computed from this runoff. This "C" value was used in the drainage equation $Q = CM^{5/6}$ to determine the required capacities of the channels.

Both public and private road crossings will be used for grade-control structures having drops of 0.5 to 2.0 feet to flatten the hydraulic gradient on some of the laterals. It is estimated that six grade-control

Investigations

structures will be needed. One of these will be located on Lateral No. 6 because of the steep grade and others will be located at the beginning of the channel work on some of the laterals (see project map). The structures will consist of a weir made from sheet piling with sand-cement bags used to stabilize the area below the structures.

A detailed geologic investigation may find isolated areas in some of the laterals that may be unstable. Because these areas are expected to be small and isolated, they can be handled in normal final design procedures. A floodway will provide for the increased stage from Station 338+50 to Station 418+00 (through State Road 1128) caused by channel work.

Rated cross sections below the channel work indicate the channel and swamp will provide an adequate outlet with no significant increase in stage.

Channel bottoms will be a minimum of four feet below cropland to allow adequate depth of drainage.

A cost estimate for all public road modifications was obtained from a representative of the N. C. Division of Transportation and Highway Safety. The Seaboard Coast Line Railroad representative provided cost estimates for the railroad modifications:

Velocities for "as built" channels using the allowable velocities method in Technical Release No. 25, Planning and Design of Open Channel, range from 2.3 to 2.7 feet per second. These velocities are somewhat lower than those listed in Table 3, "Structural Data - Channels", (2.7 to 4.8 fps). Based on field observation of other similar channels in North Carolina, these designed "as built" velocities will not cause any significant degradation. A 25-foot strip of the spoil will be seeded immediately upon completion of construction. Temporary seeding of channel banks will protect against erosion until permanent vegetation is established. Native vegetation should provide a good bank cover during the second "growing season" following construction. The designed channel bottom elevation for the lower end of the main channel (below N. C. 211) will approximate the existing bottom of the channel constructed in the Thirties. Considering the above statements, it is expected that the designed channel will be stable.

Economics

Economic investigations and analyses were based on methods approved by the Service in benefit-cost evaluation of land and water resource projects. Basic data were obtained from local farmers and businessmen, agricultural workers, city and county officials, local property owners, and U. S. Department of Agriculture publications, and other secondary sources.

Investigations

Adjusted normalized prices were derived from data approved by the Inter-Departmental Staff Committee, Water Resources Council, on April 20, 1966. Prices, production costs, and harvest costs were based on adjusted normalized prices. Prices used to compute installation costs were 1972.

Owners and operators of land to be benefited by the project and agricultural workers were interviewed to help determine present and future without project and future with project land use and yields.

Indirect damages and damage reduction benefits were estimated based on the following percentages: crop and pasture - 10 percent; roads and bridges - 25 percent; and commercial property - 20 percent.

Secondary benefits calculated were based on those "stemming from" the project and those "induced by" the project. The benefits calculated as those "stemming from" the project were based on direct primary benefits. The benefits "induced by" the project were based on increased cost that the producers will incur as a result of increased production. This method is prescribed in the Economics Guide, Chapter II, Section II.

Redevelopment benefits were estimated in accordance with the Economics Guide and paragraph 102.02212 of the Watershed Protection Handbook. Wage payments for local labor during construction were estimated to be equivalent to 20 percent of the construction cost. This value was amortized at 5½ percent for 50 years to arrive at annual redevelopment benefits from this source. Fifty percent of the annual operation and maintenance cost was used as the value of annual wages paid to local labor. This value was treated as a decreasing annuity for 20 years at 5½ percent interest and converted to an annual equivalent over the life of the project.

The inseparable flood prevention and drainage benefits to crop and pasture were estimated on the basis of difference in net income with and without the project. These benefits were allocated to flood prevention and drainage in proportion to the percent of total cost allocated to each purpose.

The installation cost of multiple-purpose structural measures for flood prevention and drainage was allocated to each purpose in accordance with the method prescribed in paragraph 103.0221b of the Watershed Protection Handbook as follows:

- (1) A portion of the multiple-purpose costs was allocated to flood prevention equivalent to the ratio of non-wetland to total area served by multiple-purpose channels.
- (2) The remaining costs were considered as joint costs and were allocated equally between flood prevention and drainage.

These steps provided the following percentages:

Investigations

- a. Percent non-wetland is of total 6.0
 - b. Percent joint cost is of total 94.0
 - c. One-half of joint cost (percent) 47.0
 - d. Percent cost allocated to flood prevention 53.0
 - e. Percent cost allocated to drainage 47.0
- (3) Estimated construction cost of multiple-purpose channel including grade-control structures. \$300,000
- (4) Amount of construction cost allocated to flood prevention
(.53 x \$300,000) \$159,000
- (5) Amount of construction cost allocated to drainage
(.47 x \$300,000) \$141,000

Details for cost sharing arrangement are as follows:

<u>Multiple-Purpose</u>	<u>P. L. 566</u>	<u>Other</u>	<u>Total</u>
Construction Cost (flood prevention)	\$159,000	\$ 0	\$159,000
Construction Cost (drainage)	70,500	70,500	141,000
Engineering Services (flood prevention)	15,900	0	15,900
Engineering Services (drainage)	14,100	0	14,100
Land, Easements, & Rights-Of-Way	0	99,000	99,000
Total	\$259,500	\$169,500	\$429,000

Geology

Channel investigations were accomplished by using bucket augers to examine material and to estimate channel bank stability. Borings were taken at representative locations throughout the watershed. All borings were described and logged in the Unified Classification System. The soil conditions revealed by this investigation indicate that bank stability problems in this watershed will be less than in most North Carolina coastal plain watersheds.

A preliminary investigation was made on one small pond site. A report was developed stating conditions on this site.

Investigations

Sediment

A complete cover survey was made of the watershed. This survey was made on contact prints and each type and quality of land use was delineated. The conservation problems, erosion, soil, soil fertility, and drainage were mapped. The data was used to determine soil loss by sheet erosion, and to determine land treatment needs.

Musgrave's equation^{1/} was used to compute soil loss from sheet erosion. Average percent of slope and needed soils information were obtained from the soil surveys in Bryant Swamp Watershed. Length of slope was obtained by direct measurements on photographs under the stereoscope. The entire watershed was studied in this manner.

The average annual erosion rates were low because very little soil is being lost from the pocosin and from the nearby level land around the perimeter. Less than one-half ton per acre is being lost from these lands. The 890 acres of sloping land adjacent to the drainageways are losing 10 to 12 tons per acre annually.

Damage from sediment deposition is very limited. Practically all sediment is dropped out in the swamps. Under present conditions, very little sediment is delivered into the mouth of the watershed.

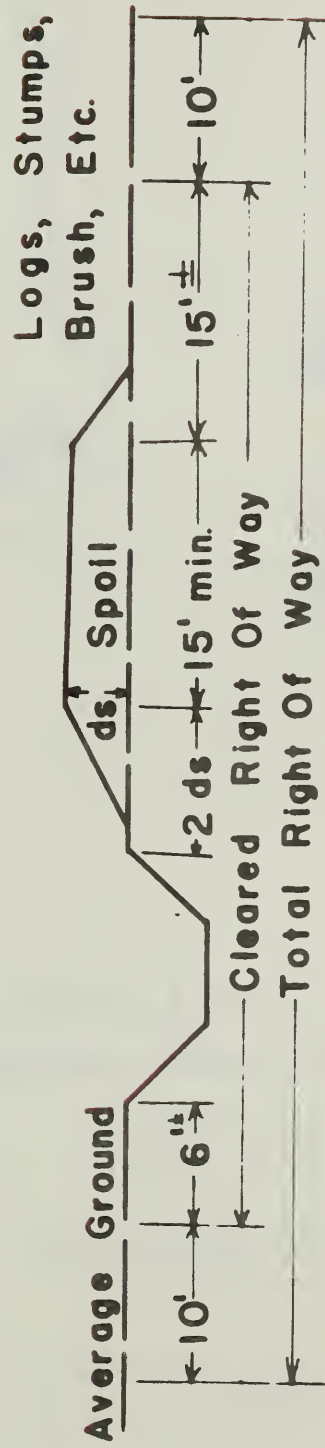
Biology

A team of biologists from the U. S. Fish and Wildlife Service, N. C. Wildlife Resources Commission, and the Soil Conservation Service carried out necessary biological field investigations. Service representatives carried out detailed investigations on two site locations to determine feasibility for wildlife wetland developments. Results of these investigations indicated that the sites were either not feasible or not practical.

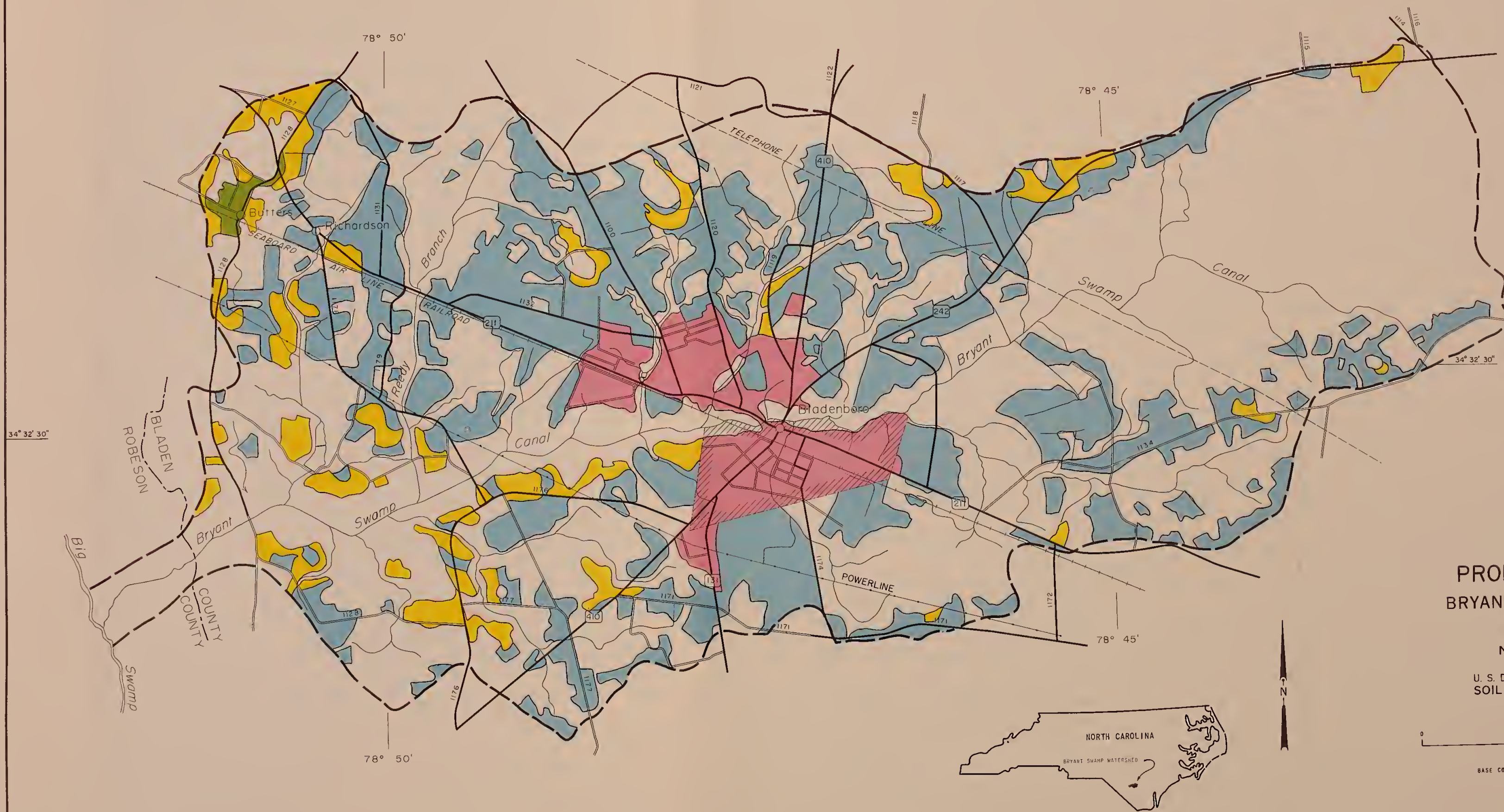
Fish and wildlife aspects of this watershed were discussed by representatives from the aforementioned agencies on two separate occasions. Items of mutual agreement were: (1) channel to extend not more than 200 to 500 feet below State Road 1128 bridge; (2) floodway construction in lower reach of channel; (3) due to existing conditions, fishery resources in the watershed are of low to negligible value; (4) most important wildlife resources in the watershed are upland species; and (5) acreage of high quality habitat in the watershed is small, located adjacent to the town of Bladenboro, and it would be impractical to attempt to install a greentree reservoir at this location.

^{1/} Musgrave, G. W., The Quantitative Evaluation of Factors in Water Erosion, Journal of Soil and Water Conservation.





Typical Cross Section Of Stream Channel With Spoil On One Side

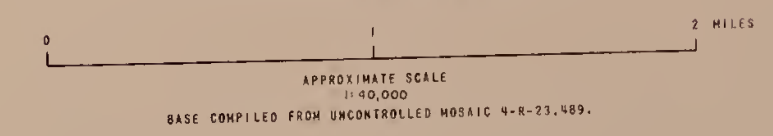


- LEGEND
- TOWNS
 - RAILROADS
 - POWERLINES
 - TELEPHONE LINES
 - PAVED ROADS
 - SECONDARY ROADS
 - DRAINAGE
 - WATERSHED DIVIDE
 - CROP AND PASTURELAND DRAINAGE PROBLEMS
 - CROP AND PASTURELAND SOIL FERTILITY PROBLEMS
 - URBAN AREA SOIL DRAINAGE PROBLEMS
 - URBAN AREA SOIL FERTILITY PROBLEMS
 - WOODLAND

PROBLEM LOCATION BRYANT SWAMP WATERSHED

BLADEN COUNTY
NORTH CAROLINA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
RALEIGH, NORTH CAROLINA



PROJECTION UNKNOWN

MAP COMPILED AT 1:25,000 AND REPRODUCED WITHOUT REGARD TO SCALE FOR MAPIMUM IMAGE ON SHEET.

2-67

Rev. 8-70

9-70 4-R-29,707
4-R-23,490



LEGEND

- 100-Year Storm Present Conditions
- 100-Year Storm With Project
- 100-Year Storm Present & Future

0 100 200 400 800
SCALE IN FEET

URBAN FLOOD PLAIN

CITY OF BLADENBORO

Bladen County, North Carolina

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
RALEIGH, NORTH CAROLINA

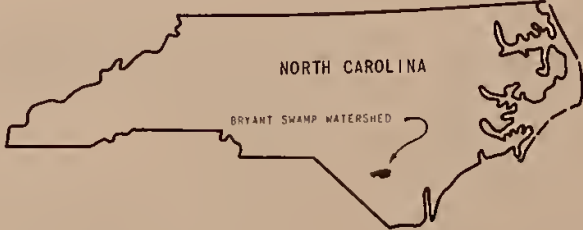
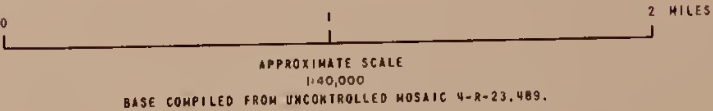


LEGEND

- TOWNS
- RAILROADS
- POWERLINES
- TELEPHONE LINES
- PAVED ROADS
- SECONDARY ROADS
- DRAINAGE
- WATERSHED DIVIDE
- MULTIPURPOSE CHANNELS TO BE IMPROVED
- AREA BENEFITED
- GRADE CONTROL STRUCTURE

PROJECT MAP
BRYANT SWAMP WATERSHED
BLADEN COUNTY
NORTH CAROLINA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
RALEIGH, NORTH CAROLINA



PROJECTION UNKNOWN

MAP COMPILED AT 1:25,000 AND REPRODUCED WITHOUT REGARD TO SCALE FOR MAXIMUM IMAGE ON SHEET.



